Compressed Air Magazine

NOVEMBER 1945

MOVING A HEAVY BARGE TO WATER

175-ton load eased down grade with aid of air brakes on trailer

Bureau of Reclamation Photo

VOLUME 50 • NUMBER 11

NEW YORK • LONDON

AIDS DRILLING OF SUBAQUEOUS ROCK

Drill Boat No. 7 of the Great Lakes Dredge and Dock Company is a fine example of modern submarine drill boats. It is equipped with four Ingersoll-Rand, steam-operated SP-8 Submarine Drills. These machines, the most powerful ever built, are the last word in submarine drill design. They weigh 10,000 lbs. apiece and strike 200 blows per minute, each blow doing more than 1000 foot-lbs. of work. Starter bits are 5 inches in diameter, and the smallest bit used is 3⅝" in size.

Without proper drill steel, these powerful machines would be crippled, for drill steel is the spearhead of the entire blasting process. Crucible Steel Company of America, because of its long experience in manufacturing hollow drill steel, was asked to tackle the problem of making a spearhead that could take the punishment.

Using knowledge gained from years of experience to overcome the special handling problems which arose, Crucible produced 3" hollow round drill steel in 55-foot lengths. This drill steel, the largest ever made, has a 1¼" hole in the center which permits the passage of air or water through the steel so that the rock cuttings can be removed from around the bit. This hole, like that in Crucible's regular hollow round drill steel, was formed by the metal core process which assures the best possible drill steel life.

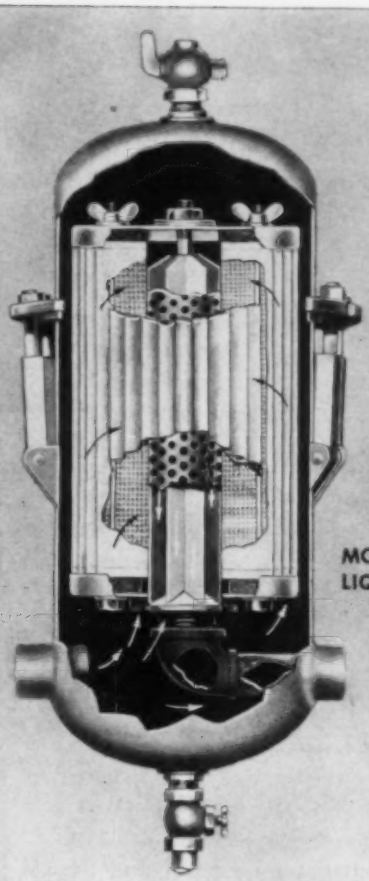
The above is an unusual hollow drill steel application as regards size and length. The widespread acceptance of regular Crusca hollow drill is evidenced by its universal selection for most major construction projects including Pennsylvania Turnpike, Delaware Aqueduct, Metropolitan District (Calif.) Water Supply, C & O Railway (14 Tunnels), Boulder Dam and many war projects for the Armed Forces.

CRUCIBLE STEEL COMPANY of America

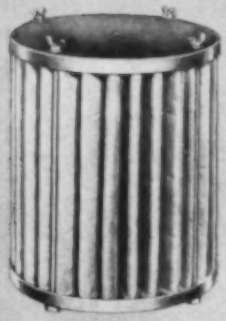
"FULL-RANGE" QUALITY STEELS for INDUSTRY

CHRYSLER BUILDING • 405 LEXINGTON AVENUE • NEW YORK 17, N. Y.
BRANCHES, WAREHOUSES AND DISTRIBUTORS IN PRINCIPAL CITIES

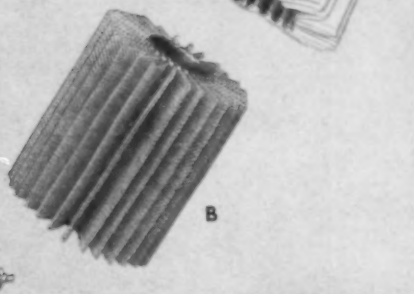
HIGH SPEED · TOOL · STAINLESS · ALLOY
MACHINERY · SPECIAL PURPOSE STEELS

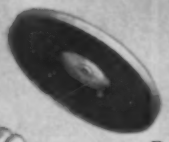


MODEL ELS
LIQUID FILTER



INSERT ASSEMBLY
REMOVED FROM
PRESSURE HOUSING





D

C

B

A

EXPLODED VIEW OF
INSERT ASSEMBLY

A. Bottom plate, gasket and through bolts.
B. Finned insert form.
C. Slip-On Type filtering medium.
D. Top plate and gasket.

MOST VERSATILE LIQUID FILTER EVER DEVELOPED

SUPERIOR to any other filter in flexibility and versatility. Puts you ahead of changes that tomorrow may bring. Provides unusual efficiency and economy. Already field-tested over a broad range of applications.

WIDE VARIETY OF FILTERING MEDIA

Design permits use of media to suit practically every requirement. Any medium—metallic, plastic, or fabric—that comes in sheet form and can be crimped may be used. Tested media include types resistant to both hot and corrosive liquids; also types to remove dirt particles down to 2 microns (.000078") or less in size.

NEW *SLIP-ON* INSERT FOR QUICK CHANGE OF MEDIUM

METHOD OF REMOVING SLIP-ON INSERT

An entirely new idea in the application of filtering medium, the STAYNEW SLIP-ON INSERT, permits quick change or replacement of medium.

LOW FIRST COST, LOW MAINTENANCE COST

Volume production of a basically economical design means low initial cost. Ease of cleaning or replacement of medium mean low maintenance cost.

LARGE FILTERING AREA IN SMALL SPACE

The well-known Staynew Radial Finned Insert Construction provides the largest possible filtering area for available space.

•

Model ELS Filters handle a total of 105,000 gallons per minute in one large industrial plant.

•

REPRESENTATIVES IN PRINCIPAL CITIES

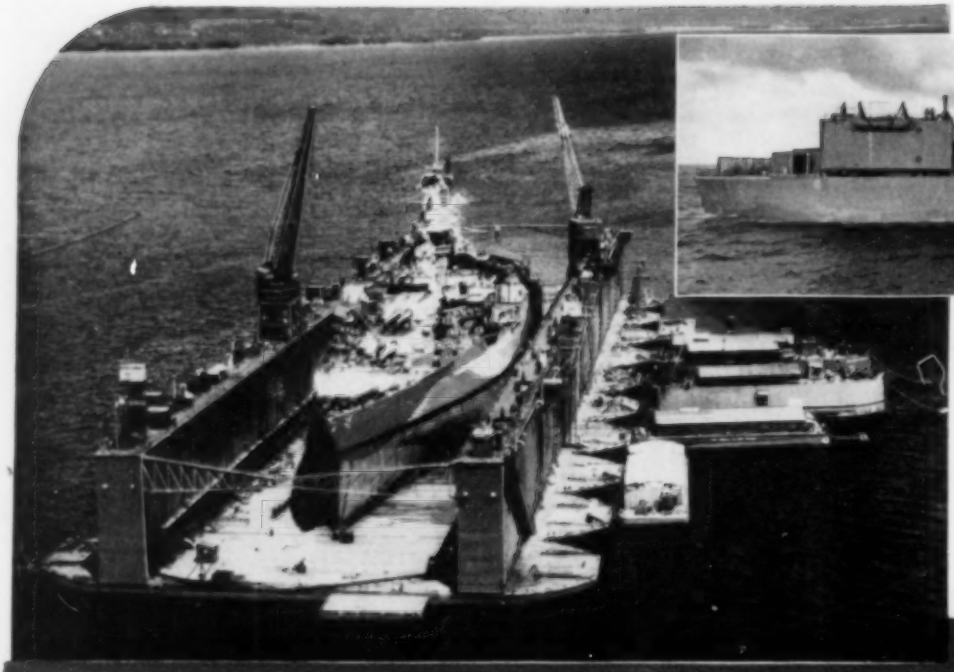
STAYNEW PROTECTOMOTOR FILTERS

DOLLINGER CORPORATION

(Formerly Staynew Filter Corporation)

Silver Anniversary 1920-1945

7 CENTRE PARK, ROCHESTER 3, N. Y.



Above: A section of the floating dry dock being towed to forward area by Liberty Ship in convoy.

Left: Ten sections welded together at advance base will handle Navy's largest ship.

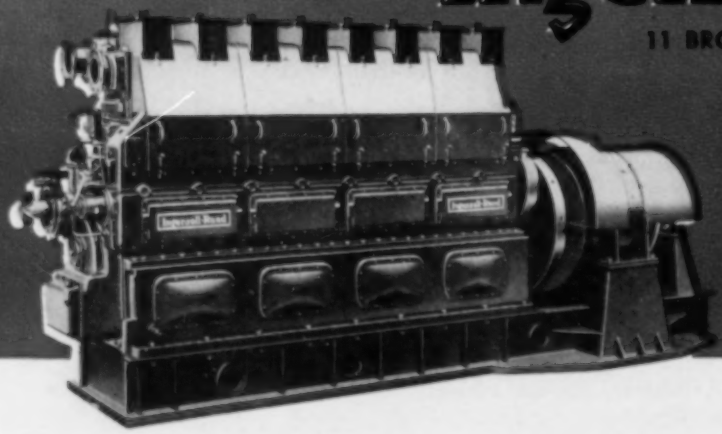
KEEPING 'EM *in fighting trim*

NAVY'S SECTIONAL "FIELD HOSPITALS" FOR DISABLED SHIPS GO WHERE THEY ARE NEEDED

When the air-tight hulls submerge, the damaged fighting craft enters the dry dock ...Water is then pumped out and the buoyancy of the hulls lifts the dry dock to the surface... Repairs are completed and another warship is ready for more action...

These "floating hospitals" accommodate our largest battleships at advanced bases. In one eight-month period they handled 176 ships.

All of this takes dependable power to operate the pumps and cranes and tools necessary for ship repairs. Each hull has its Diesel-electric power plant—ninety per cent of these are Ingersoll-Rand Type "S" Diesels.

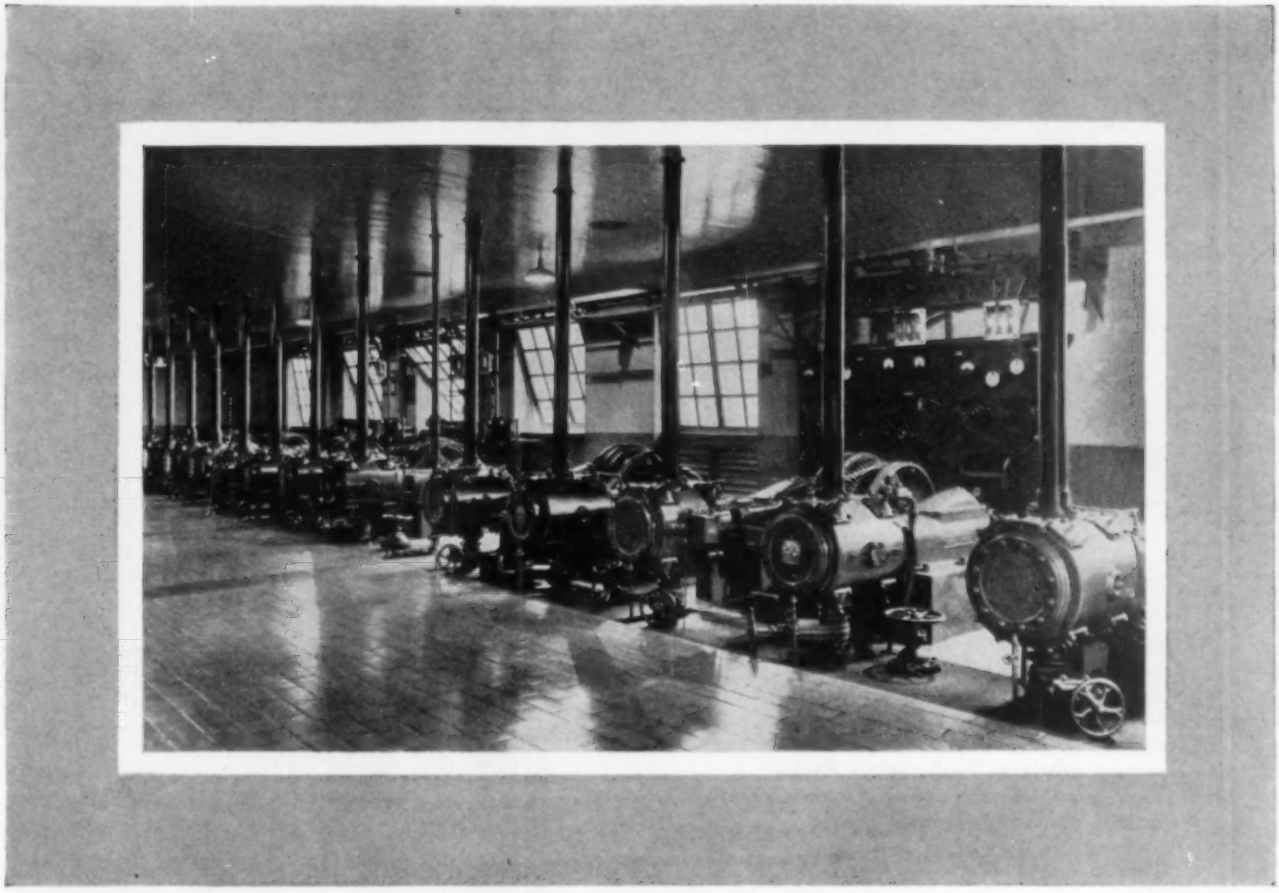


Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

ROCK DRILLS
AIR TOOLS
COMPRESSORS
CONDENSERS
TURBO BLOWERS
CENTRIFUGAL PUMPS
OIL AND GAS ENGINES

7-780



Better performance at lower cost

when you use compressor oils that . . .

★ Prevent hard carbon deposits

★ Prevent ring-sticking

★ Assure wide-opening, tight-shutting valves

★ Keep ports open, air lines clear

THESE benefits—yours with *Texaco Alcaid, Algol or Ursa Oils*—are definite assurance of efficient, economical air compressor operation, of longer service life between overhauls, fewer repairs and replacements.

Texaco Alcaid, Algol and Ursa Oils are excellent examples of the way Texaco research and refining know-how team up to improve the basic lubricating qualities of carefully selected crudes. These fine compressor oils are processed in one of the world's largest refineries. Anywhere in the world you can be sure of absolute uniformity because The Texas Company keeps every step of production, from well to finished product, under the constant control of its experienced technicians.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write to:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS

RockerShovels

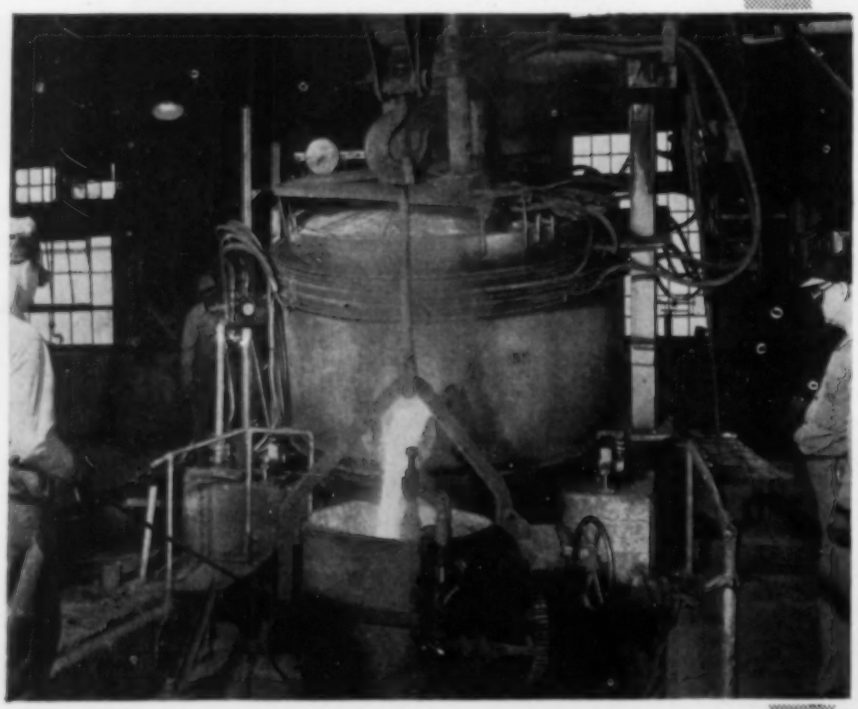
BUILT FOR BATTLE

Even though the battles of World War II have ended, the battle for production will continue so that industry may quickly restore the material needs of men in a peaceful world. RockerShovels are built for battle—the alloy steel castings that make up the sinews of a RockerShovel are made in Eimco's electric furnaces — from raw materials to finished products strictest supervision guarantees RockerShovel operators a trouble-free machine. Underground, the battle for production is not an easy one—the going is always tough, but every part of a RockerShovel has been built to take it —machined parts have been made on the most modern precision tools, every RockerShovel has been inspected and tested before it enters the battle of production.

That's why RockerShovels operate continuously month after month, load more in less time, with maintenance costs that are lower than those of any competitive type of machine.

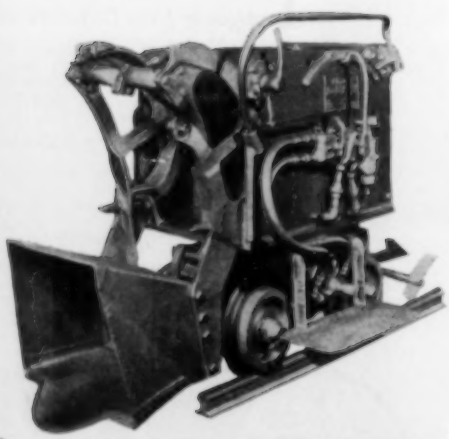
Eimco, the pioneer of rocker-arm loading equipment, is in position to give you authentic information on loading jobs. Your inquiries are invited.

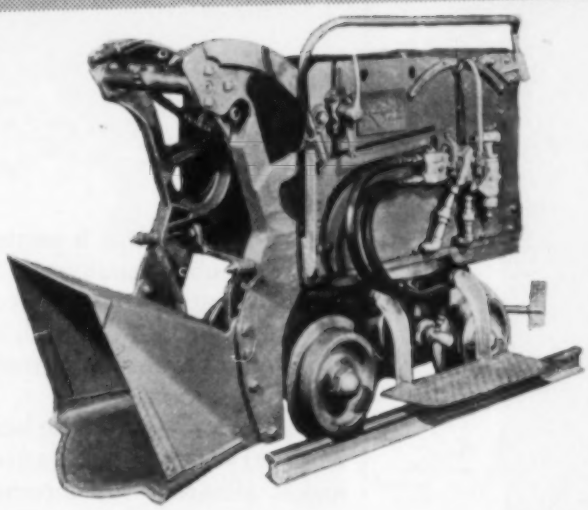
Eimco RockerShovel



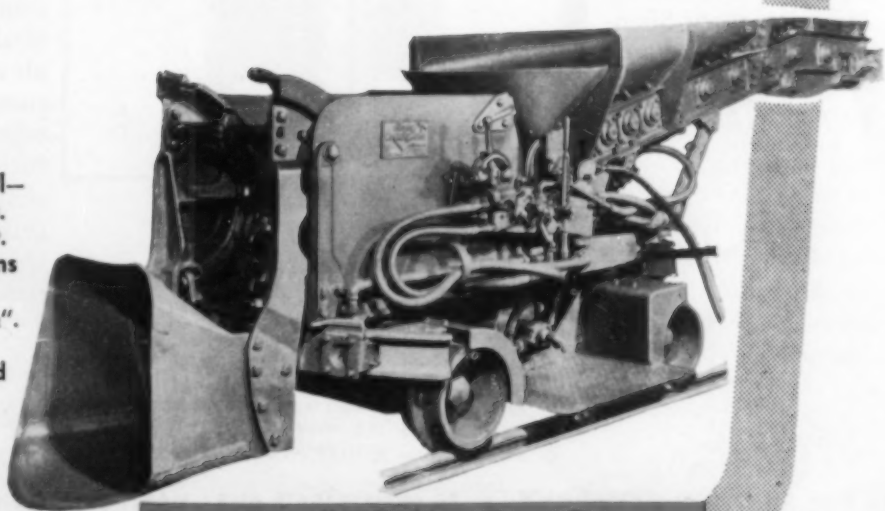
View showing electric furnace in Eimco's steel foundry. Steel castings for RockerShovel decks, gears, wheels, etc. are all made in this foundry.

Model 12B RockerShovel—
Weight 4200 pounds.
Cleanup range 8 feet.
Loading speed 1—2 tons per minute.
Track gauge 15"—36"
Air powered models only.
Min. caging dimensions 28"x42".





Model 21 RockerShovel—
Weight 7200 pounds.
Cleanup range 10 feet.
Loading speed 2—3 tons per minute.
Track gauge 18"—48".
Air or electric powered models.
Min. caging dimensions 33½"x50".



Model 40 RockerShovel—
Weight 15,900 pounds.
Cleanup range 16 feet.
Loading speed 3—5 tons per minute.
Track gauge 30"—56½".
Power swing.
Air or electric powered models.

EIMCO

THE EIMCO CORPORATION

Executive Offices and Factories: Salt Lake City 8, Utah
Branches: New York, Chicago, El Paso, Sacramento, St. Louis

A104

SAVE FUEL

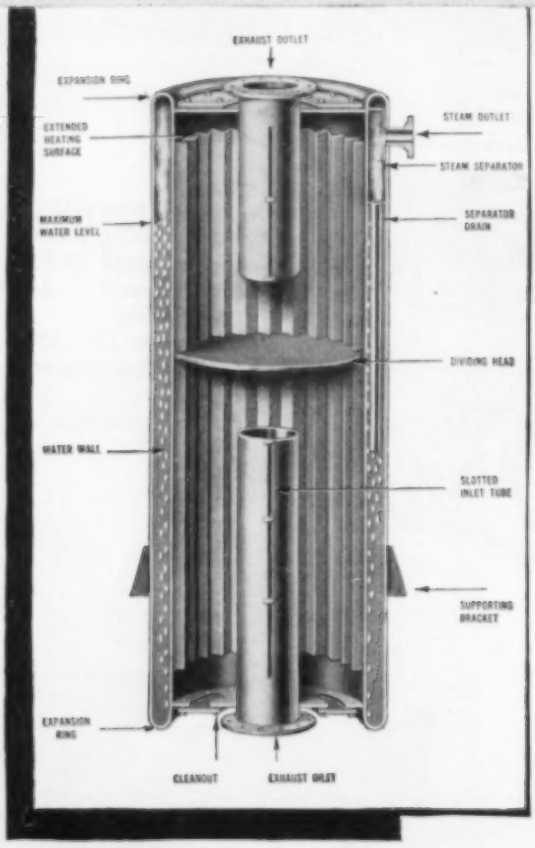
PUT EXHAUST HEAT TO WORK WITH

MAXIM HEAT RECOVERY SILENCERS

There are few industrial plants that would knowingly throw away fuel, and yet many do just that when they allow engine exhaust heat to escape without making use of it. Maxim Heat Recovery Silencers utilize exhaust heat to produce steam or hot water for heating or processing operations. They combine in one unit effective silencing of exhaust noise, spark arresting (where necessary) and efficient heat recovery.

From an efficiency point of view, the value of using Maxim Heat Recovery Silencers is obvious. Engine exhaust must be silenced as a matter of good public relations. The use of Heat Recovery Silencers accomplishes this and, in addition, produces "fuel-free" steam or hot water.

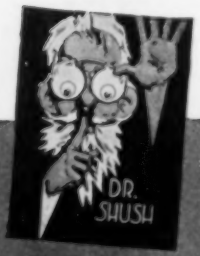
For silencing without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



Write for Bulletin

Bulletin WH-101 is an eight page illustrated folder showing various types of heat recovery silencers and also practical working hook-ups. A copy will be sent promptly on request.

THE MAXIM SILENCER COMPANY • 85 HOMESTEAD AVE., HARTFORD, CONN.

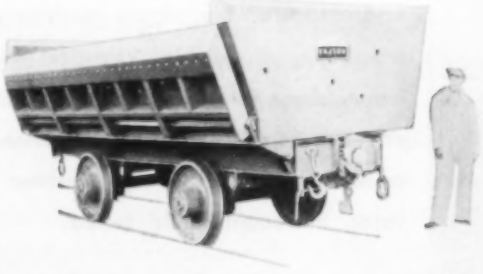


ARMY E NAVY

MAXIM

After your FIRST MILLION TONS

You might be like one user who installed EASTON TRAILERS in 1941. On that operation our engineer has just reported a total haul of almost 1,000,000 tons of rock *per unit*—with repair costs down near one hundredth of a cent per ton. We don't consider you a satisfied customer until peak efficiency like that is assured. We can relax after your first million tons.



EASTON MODEL CB-1520 QUARRY CAR

Featuring an automatic down-folding side door with the door actuating mechanism completely enclosed for protection against damage during shovel loading. Built for standard 4'8½" gauge with standard full size MCB couplers. 33" wheels (Timken Bearing Equipped) on spring suspended axles. Dumped by Easton electric overhead hoist. Capacity 20-25 tons; smaller or larger.

Want bigger production, lower haulage costs? Call freely on Easton engineering service to assist you in the design and construction of your mine and quarry cars, truck bodies and trailers. Write to: Engineering Counsel, Easton Car & Construction Company, Easton, Pa.

EVERY TON IS AN EASY TON with

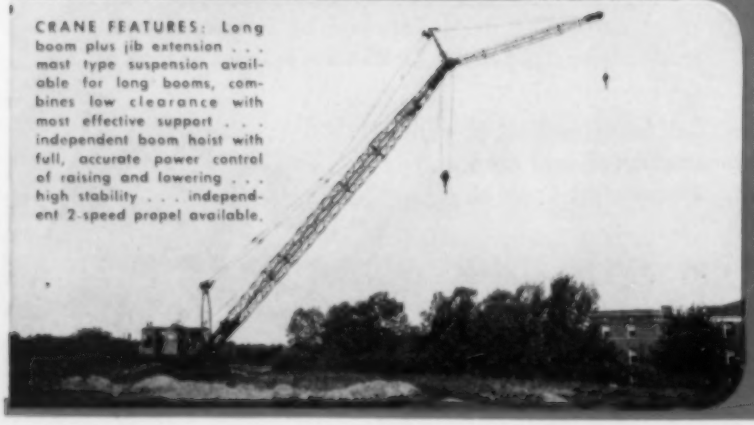
EASTON
TRAILERS · TRUCK BODIES
CARS · ELECTRIC TRUCKS
ENGINEERED

B-1019

A New OUTPUT LEADER

SHOVEL FEATURES: Strong, light boom with big point sheaves for effective application of digging force . . . independent, positive, twin rope crowd . . . high lip, curved door dipper for fast filling and dumping in rock and dirt.

DRAGLINE FEATURES: Big working ranges . . . full rotating fairlead . . . big treads for ample bearing area (convertible from flat to tapered ends in field) . . . fully responsive control . . . oversize brakes.



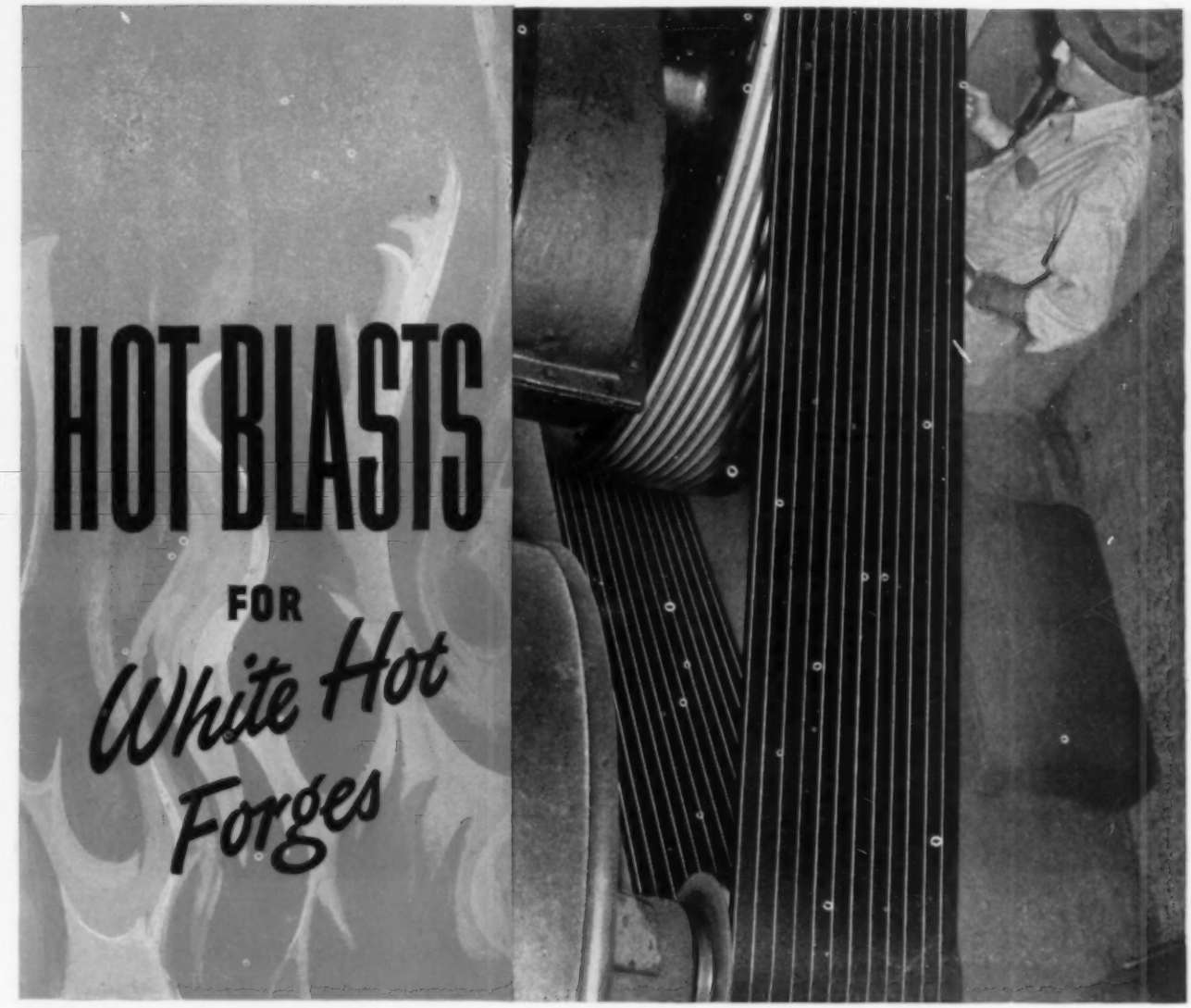
CRANE FEATURES: Long boom plus jib extension . . . mast type suspension available for long booms, combines low clearance with most effective support . . . independent boom hoist with full, accurate power control of raising and lowering . . . high stability . . . independent 2-speed propel available.

Remarkable balance of speed and power in crowd (or drag), hoist and swing gives the 38-B the smooth, fast operating cycle that spells big output on every job. Selection of the most modern materials, efficient weight placement and widespread use of selective hardening result in a machine with ample strength for continued tough digging, but without a pound of excess weight to slow it down. Anti-friction bearings and oil-enclosed gears add to smooth operation and long life. Big, simple machinery units are easily accessible, require minimum maintenance for top performance. Equally effective as shovel, dragline, clamshell, or crane, the 38-B is a real postwar excavator, thoroughly field tested.

It's new . . . it's fast . . . it's long-lived! It's just what you need in a 1½-yd. machine to put you in good position in the competitive peacetime years. Find out the full story on the 38-B from your Bucyrus-Erie Distributor.

36E45C

BUCYRUS-ERIE
SOUTH MILWAUKEE, WISCONSIN



with greater safety . . . less noise . . . and greatly increased efficiency!

To make certain there would be no failure of the forges—the fiery heart of locomotive shops—one railroad replaced a less efficient power drive with Dayton V-Belts on the huge blower that creates the air blasts for many forges. This Dayton V-Belt drive is operating continuously under steady load, and the management reports a greatly increased efficiency over the old type drive, *plus* the elimination of a bad safety hazard, and a considerable reduction in noise.

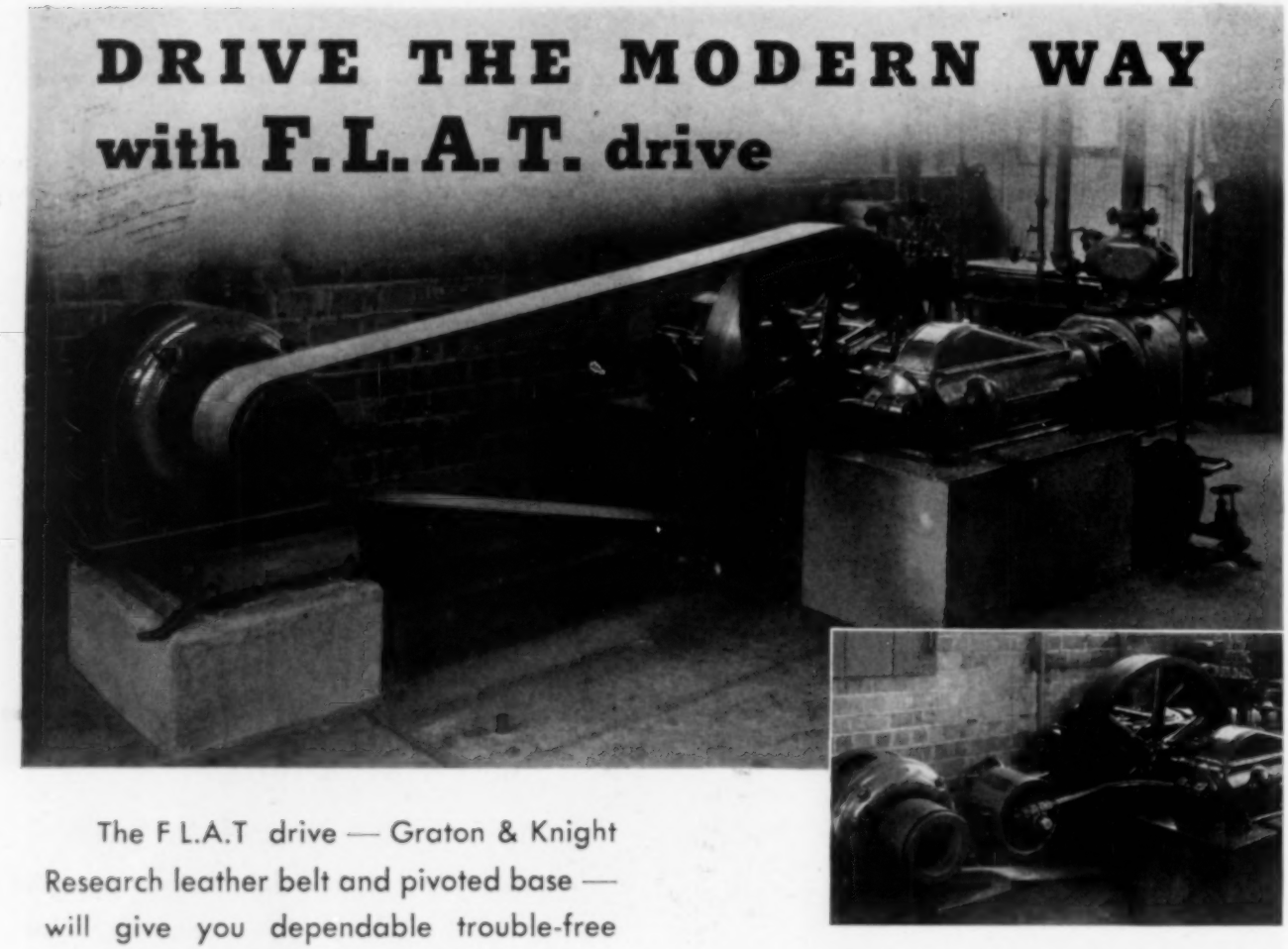
The ability of Dayton V-Belts to handle the toughest power transmission drives is a result of Dayton's 40 years of research and technical experience gained in manufacturing natural and synthetic rubber products. Your Dayton V-Belt Distributor can put this experience to work for you quickly and profitably. He is as near as your telephone. Call him today!

THE DAYTON RUBBER MANUFACTURING COMPANY
DAYTON 1 • OHIO

V-Belts by
Dayton Rubber
REG. TRADE MARK THE DAYTON RUBBER MFG. CO.
THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

DRIVE THE MODERN WAY with F.L.A.T. drive



The F L.A.T drive — Graton & Knight Research leather belt and pivoted base — will give you dependable trouble-free service on your compressor drives.

The pivoted base automatically maintains the proper tension whatever the load characteristics may be: high starting, fluctuating or shock.

Research leather belting possesses maximum flexibility, high tensile strength, high co-efficient of friction and natural elasticity — just the expectant qualities to assure the success of your toughest compressor drive.

The Proof: In a large chemical plant, the idler shown in the small illustration was eliminated and a Flat Leather Automatic Tension drive was installed. Belted by an 8" double Research this compressor drive has been operating 12 hours a day. **In over two years the belt has required no take-ups — the drive, no adjustments.**

This modern F.L.A.T. drive transmits more power, eliminates idler bearing replacement and increases belt life.

Write Graton & Knight Company, 365 Franklin St., Worcester 4, Mass., for 56-page manual, giving engineering data on this and other types of drives.

GRATON AND KNIGHT

Research Leather Belting

The most complete line . . . manufactured under one control from green hide to finished product. Graton & Knight distributors are listed under "Graton & Knight" in "Belting" section of Classified Telephone Directory and THOMAS' REGISTER.

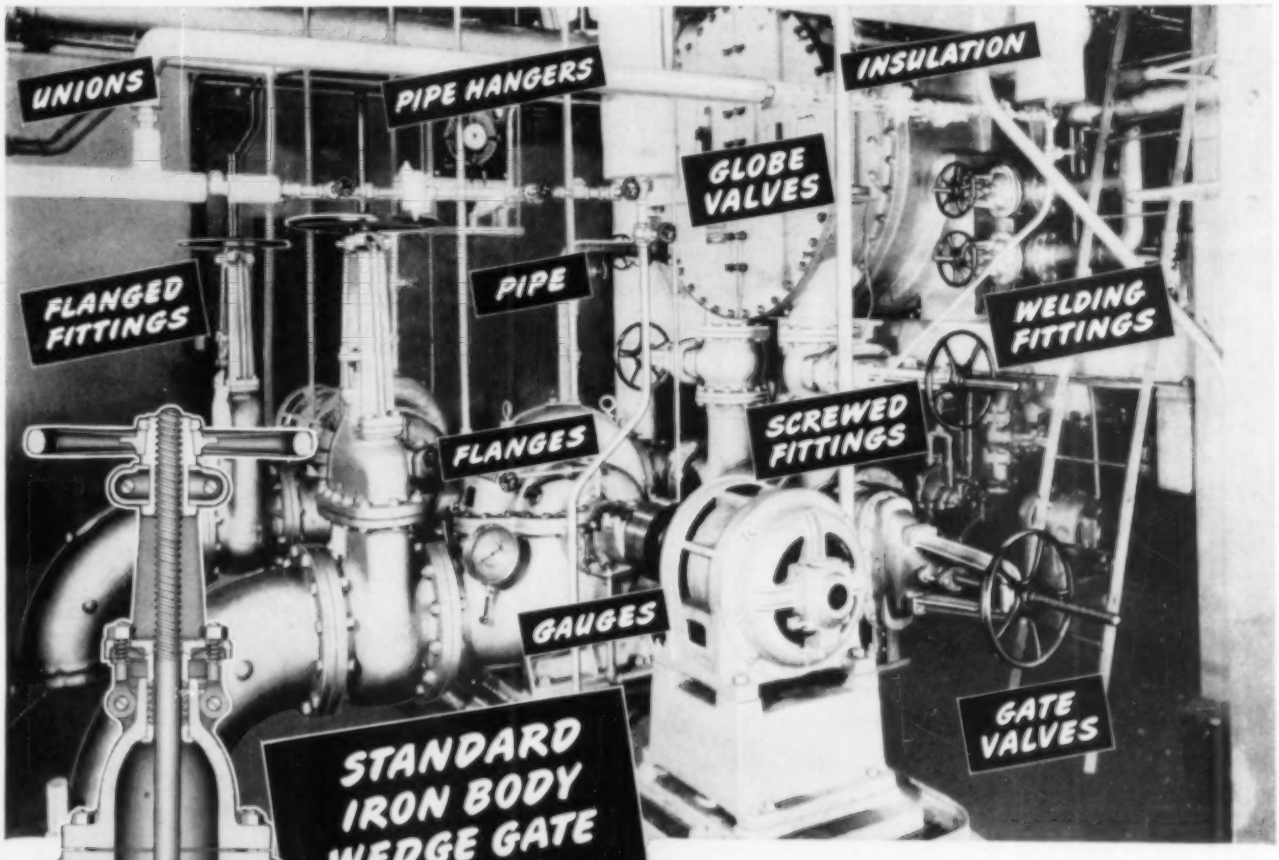
Where CRANE Can Help You in Piping Problems

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

The conditions under which your piping systems operate govern your choice of piping materials. You can best determine the exact requirements. In that task you will find the Crane line a *truly* helpful service. By giving you the world's most complete selection of piping equipment for all applications, Crane makes it possible to get exactly what you need. You choose with complete confidence, for Crane, with 90 years' experience, points out clearly the distinct advantages of each type of valve, fittings and piping accessory.

In choosing Crane materials, you simplify any piping job. One order to your Crane Branch or Wholesaler covers all your needs. Uniform quality in all materials—plus single responsibility for them—helps keep installations at peak efficiency longer—at minimum cost. For maintenance or new work, the Crane line answers all piping equipment problems.

Condenser and circulating water pumps in power plant



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in factories and power plants, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O. S. & Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

Working Pressures

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16 in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2 in., use Crane Clamp Gate Valves.)

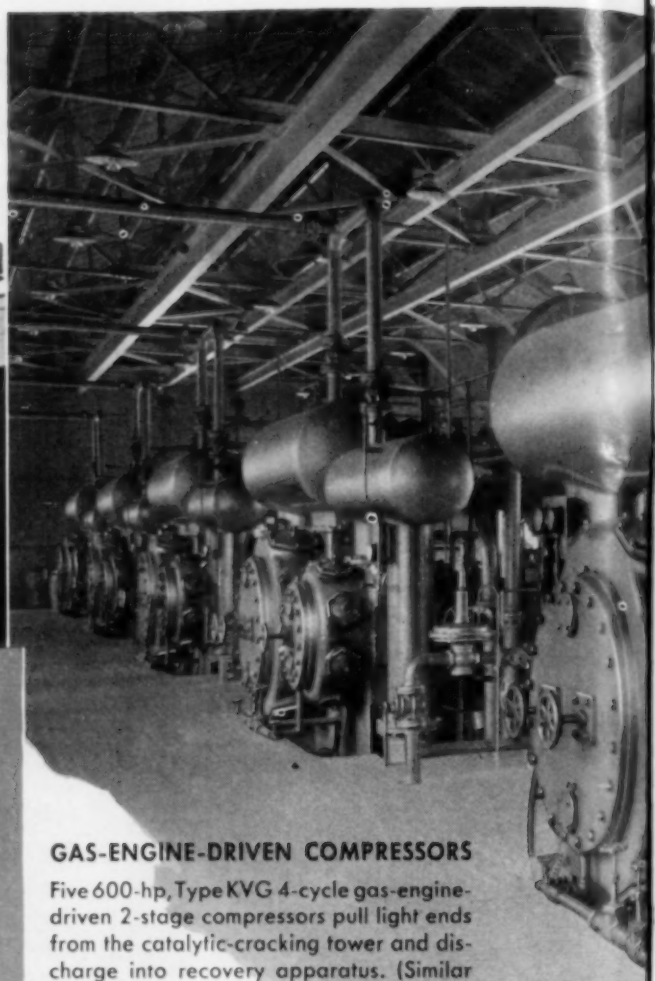
CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

90 YEARS OF PROGRESS 1855 1945

VALVES • FITTINGS • PIPE

PLUMBING • HEATING • PUMPS



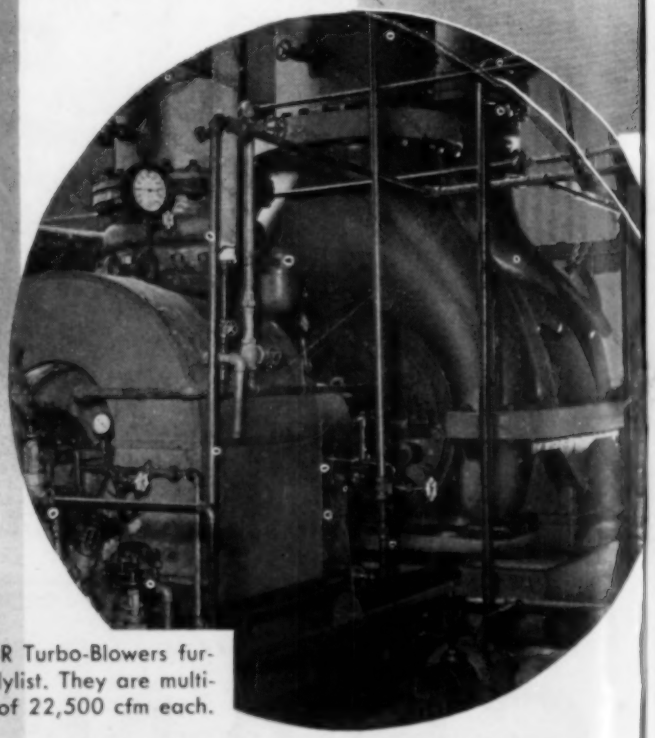
I-R COMPRESSORS TURBO-BLOWERS PUMPS *in* *Baltimore Catalytic Cracking Plant*

These machines are there because they have extra-special ability to stay on the line. Ingersoll-Rand's wide experience in the petroleum, chemical, and process industries provides a background of knowledge that enables I-R engineers to predict in advance what might cause a shut-down of a machine. Then, with unexcelled engineering and manufacturing facilities, they design and build a product that reduces to a minimum the possibilities of a failure or shut-down.

Whenever you have problems of handling liquids and gases under pressures, vacuum, or refrigeration, let Ingersoll-Rand help you.

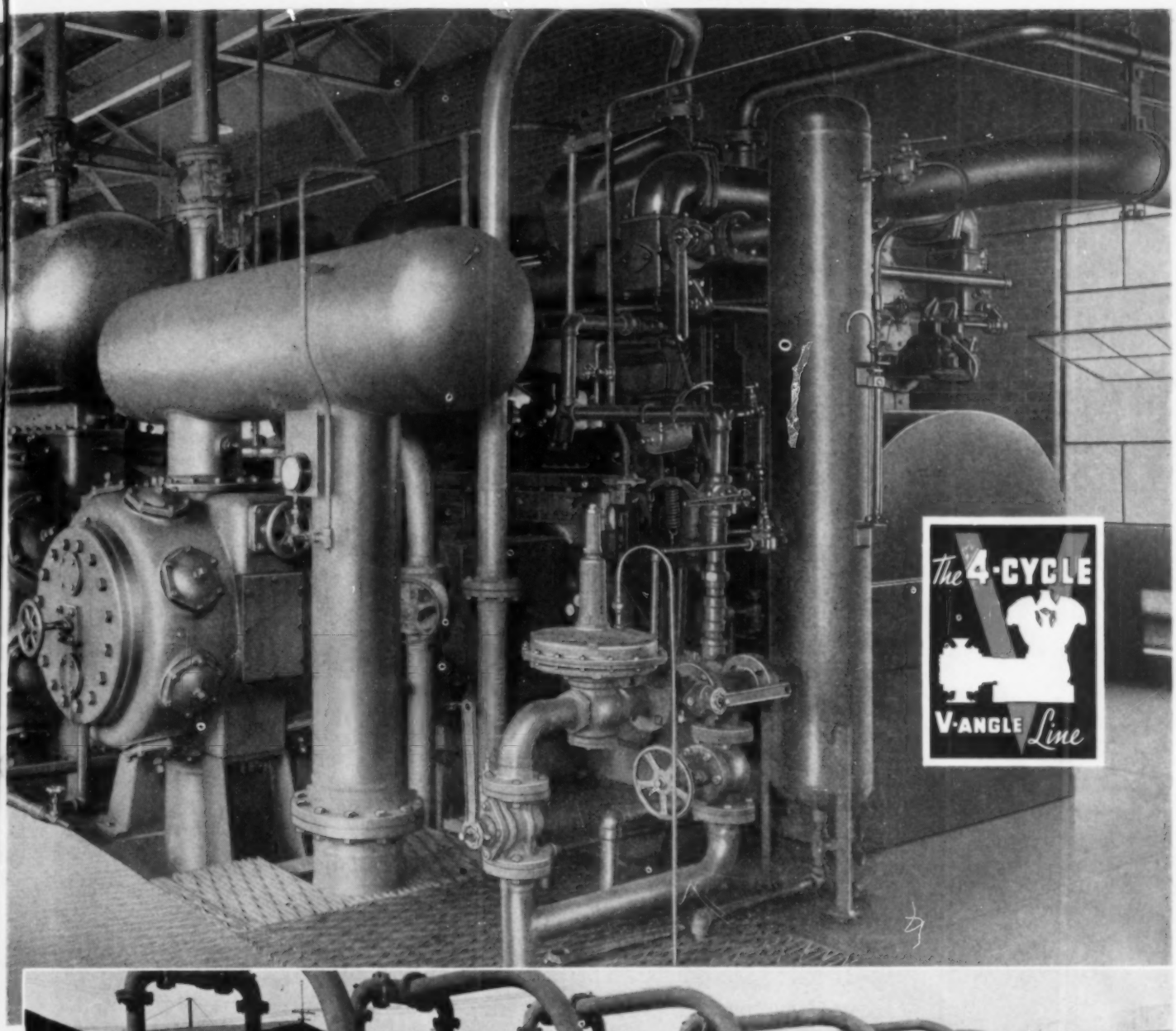
GAS-ENGINE-DRIVEN COMPRESSORS

Five 600-hp, Type KVG 4-cycle gas-engine-driven 2-stage compressors pull light ends from the catalytic-cracking tower and discharge into recovery apparatus. (Similar I-R compressors are available from 75 to 1000 hp.) Ingersoll-Rand 2-stage air-cooled compressors supply starting air for these machines.



TURBO-BLOWERS: Two 1700-hp I-R Turbo-Blowers furnish air at 15 psi for the fluid catalylist. They are multi-stage units with a free-air capacity of 22,500 cfm each.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES



PUMPS: A battery of remote-controlled Ingersoll-Rand Motor-pumps handle gasoline and fuel oils from storage. Other I-R pumps in the refinery include three large 16-inch pumps handling brackish bay water for general service.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 14-791

WHEN THE BASIC PART IS A FORGING— THE FORGING MUST BE BASICALLY RIGHT

The crankshaft of a Diesel engine—the rotor shaft of a steam turbine—the spindle of a machine tool are typical of the "basic" functions forgings must perform in making engines, power plants and machinery live up to "their good name" in actual service.

When you buy such a forging, you want faithful adherence to specifications but you also want something more. You want an inherent quality that spells longevity and freedom from trouble. To possess these qualities a forging must be born of clean steel and handled with constant skill through all the critical stages of forging, heat treating and precision machining.

It takes equipment, experience and men who really have the "know how" to produce that kind of forging—and that is the only kind of forging worth while buying, if your reputation hinges on how that forging performs. Let National Forge tell you about it now, for National Forge can serve you now.

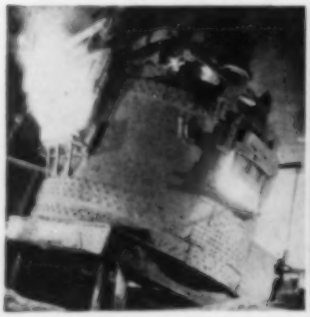
Have you read this book? If not, write for it now.

NATIONAL FORGE & ORDNANCE CO.

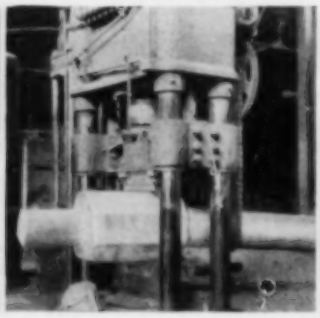
IRVINE, WARREN COUNTY, PENNSYLVANIA

"WE MAKE OUR OWN STEEL"

ELECTRIC STEEL



HYDRAULIC FORGING



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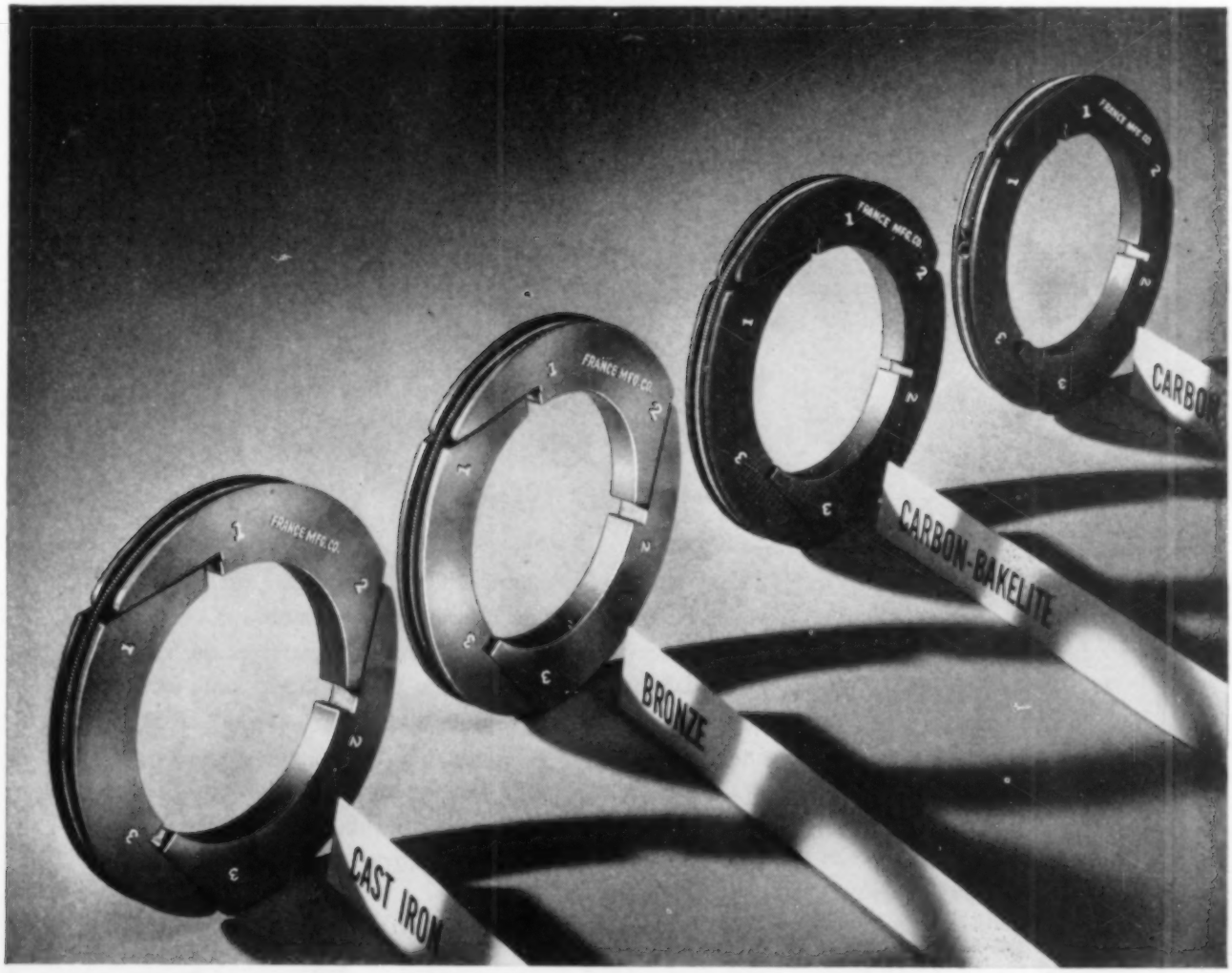

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NORTON COMPANY - WORCESTER 6, MASS.

* Hardest Material Made by Man

ON THE COVER

WITH Grand Coulee Dam in the background, a new 81-foot steel barge, weighing 350,000 pounds, is shown as it is being eased down a steep grade to the Columbia River for launching. It is carried on a 16-wheel trailer equipped with hydraulic steering gear. The rate of descent is controlled by three 10-ton diesel trucks pulling on cables at the rear. In addition, the trailer has powerful air brakes for emergency application. Compressed air for operating them is supplied by a portable compressor mounted on the truck in front. The barge, which was built in record time by Bureau of Reclamation employees, will be used to transport material dredged from the Columbia River downstream from Grand Coulee Dam.

•

IN THIS ISSUE

SILICA gel, which was developed during the first World War, was put to important uses in World War II. The story of this hygroscopic material is told in our leading article.

•

PALLETIZING is a relatively new word that might be loosely defined as packaging for easy handling and transportation. The article on pages 286-7 describes successful experiments in palletizing Portland cement.

•

TRAFFIC problems are not confined to this country. In Melbourne, Australia, two bridges, one built in 1860 and the other in 1884, carry on an average one train every 2½ minutes of the day and night. A new concrete crossing is now being erected to replace them. Its construction involves considerable use of air-operated equipment. Page 288.

•

SALT is such a common substance that it is seldom given due consideration. As the article that begins on page 291 points out, it is perhaps our most useful mineral. The nation's salt production last year amounted to 240 pounds per capita. Of that total, about 9 pounds entered into the food each of us ate.

•

DOCTOR W. F. Gericke, University of California scientist who gave to soilless gardening the name "hydroponics," contributes an article on that subject which supplements M. R. Vogel's piece in our June issue. (Page 295).

Compressed Air Magazine

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Silica Gel
Did Its War Work Well

R. G. Skerrett

SHIPS AND SHOES AND SEALING WAX

The two pictures on the next page give an idea of the enormous quantities of materials that had to be transported to meet the needs of our overseas armed forces. The upper view shows a temporary store of goods on one of the islands in the Pacific. Many of the articles, ranging from airplane engines down to typewriters and wrist watches, had to be protected from corrosion. They were carefully packaged to exclude moisture and additionally safeguarded by including one or more bags of silica gel to dehydrate the atmosphere surrounding them.

HOW the infinitessimally small has bulked large in helping us to wage war on two fronts is the record of a Chemical Cinderella—for such may silica gel be fittingly called. Splendid as the performances of this chemical have been, it is unknown to the vast majority of us because it does its work without any parade and quietly, as did Cinderella of the fairy tale.

In silica gel we have a material that might still be familiar only to certain inquisitive laboratory workers had not the Germans, in the spring of 1915, given the Allies a staggering surprise by using poison gas first against the French and two days later against the Canadian troops near Ypres in Belgium. It is a matter of history now that both the French and the British were able later to develop headdresses or helmets that enabled the wearers to draw into their lungs air that was stripped of poisonous gases after passing through chemical filtrants and charcoal.

When we joined World War I against the Central Powers in April of 1917 we had our own Chemical Warfare Service which was able to profit by the researches and experience of the Allies. But by 1917 the essential charcoal for gas-mask canisters had become restricted owing to the special grades that were needed for that purpose. The quality desired depended upon the nature of the woody substance that formed its base, and the dense structure of coconut shells and the pits of certain fruits made them suitable or, at least, the best vegetal sources of supply. Chemists in this country were asked to seek a substitute for charcoal and, if possible, a material that could be turned out in large quantities and of uniform characteristics. This could not be assured in the case of charcoal. The matter of density of the woody substance is of prime importance because it affects the capacity of a charcoal to take up gases from the atmosphere and to hold them.

Among our investigators who were engaged in this research with the U. S. Chemical Warfare Service was Dr. Walter A. Patrick, who was then, as now, Professor of Physical Chemistry at Johns Hopkins University, Baltimore, Md. In his quest, Doctor Patrick climaxed the earlier work of the great Scottish chemist Thomas Graham who had produced, in 1860, a gelatinous mass that he called silica gel. That was in the days when colloidal chemistry had its beginnings. But what Patrick sought was a kindred substance that could be advanced to a further stage where it

would lend itself to drying and granulation and, like charcoal, be capable of drawing into it the noxious gases then being used on the battle fronts. Doctor Patrick also called his product silica gel—probably as a compliment to Graham, and so it has become generally known. But there is a wide difference between it and the silica gel of Graham's day—they are as far apart as dough is from the baked loaf. Doctor Patrick's was discovered too late to be of any service during World War I; but he accomplished what other chemists here and abroad had failed to achieve during more than half a century of recurrent efforts, and his success blazed the way for a chemical product that has many valuable applications.

Silica gel as it is made now is really not a gel. Instead, it is a rugged material that is nearly as hard as window glass and can be had in any screen sizes desired—the individual granules being as clear as crystal quartz. It is produced from a soluble silicate such as the familiar water glass that has long had various commonplace uses. But by the manufacturing process perfected after extensive research by The Davison Chemical Corporation silica gel is an insoluble material that possesses many remarkable qualities which have already been helpful in many directions and will be found of importance in still others. It has an extremely porous structure; and that was probably why Doctor Patrick believed it would serve as an adsorbent to capture poison gases.

At the plant of the corporation, a suit-

Official U. S. Navy Photos

MORE SUPPLIES

En route to the fighting zone, the hangar deck of an aircraft carrier (below) is used to store surplus goods until space can be found for them elsewhere on the ship. The other picture shows landing craft on the beach at Cape Gloucester, New Britain, being unloaded immediately following the invasion by United States Marines.

Official U. S. Navy Photos

able quantity of sulphuric acid of a predetermined concentration is actively mixed with a given amount of sodium silicate, water glass, and when they are in solution what is known as a hydrosol results. That mixture is allowed to form a gelatinous mass—a hydrogel, which was what Thomas Graham succeeded in making in 1860. After the hydrogel has "set" for a suitable time, it is broken up into small lumps that are thoroughly washed to remove any free acid and such salts as are produced through the reaction which takes place in the mixing tanks. The material is next dried and screened through mesh of different sizes to provide particles suitable for various uses. After that the hydrogel is exposed to a final heating or activation and put in airtight containers. This product goes by the trade name of Protek-Sorb and is colorless.

The silica gel in question is capable of adsorbing gases and moisture vapors and can do this because of its remarkable structural get-up. Adsorption is quite distinct from absorption. A sponge, for example, because of its cellular and porous nature, will take up a large volume of water that will fill not only the cavities of that marine growth but penetrate into the very substance of its internal structure—incidentally expanding the sponge and rendering it damp or even wet to the touch. Silica gel, on the other hand, adsorbs moisture vapor and condenses and deposits the moisture only on the surfaces of that material's pores. The vapor does not penetrate the structure of the gel, and the gel when so laden to its utmost capacity does not swell or cake but remains seemingly as hard and dry as it was when activated at the factory. The action of the chemical when exposed to moisture is a strictly physical one—not a chemical one. How and why does it act in this manner?

Protek-Sorb will adsorb at normal temperature something like 45 percent of its own weight of water from saturated air, and it will do this even though its pores are so minute that they are invisible to the eye aided by an ordinary microscope of the highest power. On the basis of the known adsorptive capacity of a cubic inch of the material, it has been mathematically determined that that small mass probably contains myriads of tiny pores that have an aggregate exposed surface area of about 50,000 square feet—in excess of an acre! These submicroscopically small tubes or capillaries exert the power of attraction to fluids, which is fully explained in elementary textbooks on physics. Protek-Sorb therefore attracts vapors, condenses them, and holds them as liquids in its pores or capillaries. Being chemically inert, it does not go into solution when it has become saturated, and there is no change in size or shape of its particles. This amazing material has no harmful effect on any other materials it may touch and gives off no corrosive or injurious compounds when active. For these reasons this Chemical Cinderella has won prominence through its numerous excellent services.

Silica gel is a seeming paradox. Although it is a colloidal form of silica, normally characterized by abrasive qualities, it is quite nonabrasive. This was proved deliberately by a manufacturer of compressors, and the following excerpt from *Refrigerating Engineering* explains what was done: "Two new compressors were carefully inspected as to bearing surfaces, cylinder walls, etc., and put in operation under full load conditions. In the crankcase of one a half teacupful of granular silica gel was intentionally added. These compressors were run for 90 days under full load conditions, after which time they were both completely dismantled and reinspected. There was not the slightest difference in the condition of the compressor in which silica gel had been added and the condition of the other compressor."

Whether or not the electron microscope will reveal to the eye the internal structure of silica gel is yet to be answered, but the physicist has let his mind's eye picture what he believes it might be. This is interestingly described by Frank C. Dehler of The Davison Chemical Corporation: "The porous structure of silica gel gives the material its power to adsorb or drink in condensable vapors. Because of the fact that the dimensions of its pores are less than one wave length of light (one millionth of a millimeter) and cannot be observed by known optical means, the nature of the internal structure of silica gel is not known exactly. Theories advanced by physical chemists regarding

the structure have resolved into several conceptions. According to one group, silica gel might be described as being a body of submicroscopic spherical silica particles tied together in a homogeneous mass similar to a pile of lead shot. Another school is of the opinion that it can be considered to be a mass of strands of silica intertwined indiscriminately and uniformly in all directions after the fashion of threads in a ball of raw cotton. Since the pores or capillaries are formed by the juxtaposition of silica particles, they are not of the same diameter throughout their length and are probably shaped like a wedge." Be this as it may, silica gel acts instantaneously and certainly when affected by moisture vapor.

The granular sizes of the material vary widely. For present requirements they range from those that will pass through a 3-mesh screen to those that can go through one of 200 mesh, but even smaller particles are to be had for special purposes. The latter serve as catalysts or catalyst carriers in chemical reactions, or as active ingredients in special adsorptive medical powders. The 3- to 8-mesh and 6- to 16-mesh silica gel is used in the separation of vapors from gas mixtures; the 14- to 20-mesh for the dehydration of liquids such as refrigerants; 42-mesh for static adsorption, such as in the prevention of corrosion, mildew, and mold in closed spaces; while 28- to 200-mesh plays its part in the purification of liquids, such as the refining of mineral oils. The coarser grades also serve as carriers for active metallic catalysts in many chemical processes, one of which is the conversion of sulphur dioxide to sulphur trioxide in the production of sulphuric acid by the contact process. Sulphuric acid, by the way, is the old wheel horse of chemistry and pulled a heavy load during the war years.

Silica gel has an important field of application in air conditioning, and especially where industrial or manufacturing processes call for the closest control of the moisture content in some operating subdivisions or compartments. Indeed, this is the case in the section of the great plant of The Davison Chemical Corporation where freshly made Protek-Sorb is packaged in small cotton bags by nimble-fingered women. That work has to be done in a relatively dry atmosphere and quickly so as to expose the silica gel to it but a brief period while being placed in sealed containers. The latter are shipped to concerns who use the chemical for products bound overseas that require protection from corrosion and other ill effects of dampness.

Truly silica gel has done its "bit" in the nation's war effort and accomplished things not contemplated when Doctor Patrick brought his laboratory work to its 1918 climax. It has been and will continue serving effectively as a catalyst in the manufacture of Buna S. synthetic rubber and as the fluid catalyst in petroleum refineries engaged in turning out high-octane gasoline in giant "Cat Crackers." As a desiccant it kept within safe limits the measure of moisture vapor present in the air surrounding naval and military shipments so as to insure their arrival in any part of the world fit for action.

In the so-called fluid catalytic cracking of petroleum, silica gel is used as a carrier, and for that purpose it is in the form of a powder capable of floating like a cloud when under the impulse of blower air and mixed with a rapidly moving stream of hot oil vapor. The particles are so small as to be barely visible to the unaided eye, but the great number of pores in even the tiny bits of silica gel causes the oil vapor entering those capillaries to come under the influence of the catalyst and so to bring about the desired cracking reaction.

In one of the plants using this process, as much as 35 tons of the particles is sent whirling continuously through a system of pipes and vessels every minute in intimate contact with the oil vapor. Inevitably, the silica-gel dust becomes fouled with carbon, but the latter can be burned off after the dust is collected. The silica gel, with the catalyst, is thus regenerated quickly and returned to the stream of oil vapor to repeat its cycle of helpful work. In the production of butadiene from grain alcohol for Buna S., silica gel also plays the part of a catalyst support.

Metallic oxide and salts serve as catalytic agents, and their effectiveness as such depends upon the area exposed by them to the reagents. Accordingly, it is desirable to increase the surface of the catalysts as far as practicable, and this can be done by employing silica gel as the carrier and impregnating it with the required metallic oxides and salts. Again, it is the amazing area of the pores of each little granule of silica gel that makes it possible to achieve the end desired without recourse to objectionable volume.

Probably the greatest aid lent by silica gel in our war effort was that of protecting vitally needed arms, ammunition, foodstuffs, and other indispensable supplies that had to be transported overseas to our fighting forces. When used in combination with an approved moisture-vapor barrier, the chemical can be relied upon ceaselessly to counter damage caused by the associate actions of oxygen and moisture and so prevent the development of rust, corrosion, mildew, and mold. Even though the harm that moisture and oyxgen can do has been known to humankind for thousands of years, we failed to take

HUMIDITY INDICATOR

By adding cobalt chloride to silica gel, there is obtained a compound that is normally blue but changes to lavender and then to pink with increasing amounts of moisture in the air. This material, termed Tell-Tale, serves to indicate at a glance when the moisture content within a package has risen so much that more Protek-Sorb is needed. The picture shows one of the humidity-indicator cards held by a worker engaged in packaging an airplane engine for overseas shipment.

DRYING UP A SPLICE

In splicing military telephone cables care has to be taken to exclude moisture, which might interfere with the proper functioning of the line. This was formerly a long and tedious task, but it is now quickly and easily accomplished by adding Protek-Sorb before sealing the material enveloping the spliced section.

suitable precautions against them when, as a nonbelligerent, we began sending shipments abroad under Lend-Lease arrangement, and our shortcomings were not much less evident for some while after we declared war against the Axis. We tried to protect the matériel by the same means long employed by us and found generally adequate in times of peace, but we did not grasp how much atmospheric conditions aggravated the problem of safeguarding against corrosion, particularly when we were called upon to ship to foreign shores remote from our accustomed trade routes and to regions where the climates differed greatly from those of our own land. Again and again our consignments reached their destinations impaired to varying degrees by the actions of moisture-laden air. This was bad even when time could be given to removing rust and the like at the points of delivery; but the situation became grave when the articles could not be used by the men sorely needing them at the very battle fronts. According to competent authorities, the losses traceable to moisture were staggeringly heavy.

A common practice even after hostilities began was to coat metal surfaces with paint or lacquer to serve both as a protection and as a finish, and to shield carefully machined parts by slushing them with oils and grease which had to be removed laboriously prior to putting the shipment in service. On many occasions that treatment impaired factory adjustments. These precautions were an acknowledgement that moisture was, in fact, an unavoidable evil. The up-to-date method of dealing with moisture is to dry the air in a package so that there will not be enough present at any time to work in combination with oxygen and thus start and accelerate corrosion. This is especially important when the nature of the consignment or other circumstances will not permit slushing with oil and grease.

Much private investigation and the experimental work of government experts have established certain facts about the conditions that tend to promote rust, mildew, and the like. Many may be surprised when told that corrosive action and other types of moisture damage will occur even though the air in which products are stored or shipped be not saturated. It is not necessary for water in liquid form to be present. Research has revealed that such action can take place even when the air in a package has a relative humidity of less than 40 percent, but that positive protection can be assured if the relative humidity be maintained at or below 30 percent. By the approved form of packaging, the relative humidity immediately in contact with an article can be kept at or below 30 percent. When this is done in the case of intricate electrical apparatus, accurately machined parts, and other matériel, they do not have to be safeguarded by slushing or plastic coatings.

To understand what the new order of packaging does, one should have a clear conception of the meaning of the term "relative humidity" and of the factors—the actual amount of moisture in any given volume of air and the temperature of the air at any given time—that control or promote it. When chilled sufficiently to bring about saturation and the deposition of dew, air has a humidity of 100 percent; and when the atmosphere falls short in any degree of this maximum, its condition is expressed in percentage of relative humidity. For instance, air at 70°F. and 30 percent relative humidity has a moisture content of 32 grains per pound of air. If this amount of moisture be doubled—namely, to 64 grains per pound of air—then the relative humidity will rise to 60 percent. Oppositely, if the moisture content remain constant and the temperature of the air be lowered, then the relative humidity will increase, and with a sufficient drop in temperature the humidity will reach the dew point. Accordingly, air that is not moist enough to cause corrosion when a package is closed or sealed may become so if the temperature drop sufficiently to bring the relative humidity high enough to start trouble. Let us make it still more enlightening. Should the air have 30 percent relative humidity at 70° and be exposed to a temperature 30° lower, the relative humidity would rise to 91 percent; and should the temperature drop 3 degrees more, the air would become completely saturated and condensation would begin.

When we transported machinery, munitions, foodstuffs, and other supplies to Newfoundland, Iceland, and Russia's arctic base at Murmansk, the packages had to be protected against great drops in temperature; and in the case of cargoes to various parts of western Europe, Africa, India, South America, China, and Australia and New Zealand, we had to guard against increases in temperature and possibly moisture-laden air. But our gravest problems were encountered in the tropical and subtropical areas of the western Pacific where the humidity is extremely high and where our packaging for a goodly while was found defective because of the insidious action of the ever-present moisture vapor that promoted rust, corrosion, mildew, and mold upon and within the war materials.

Whether shipments were carried on open decks or stowed in the holds of vessels where sweating often occurs, or whether, upon reaching their destinations, they were held under cover or in open storage for long or short periods, moisture vapor was always ready to start its damaging cycle. No wonder the responsible men at the bottle fronts repeatedly asked that every care be taken to protect munitions and supplies from the "four evils," to see to it that shipments would still be factory-fresh when unpacked and in condition for immediate use. It was not enough to produce the needful quantities of arms, ammunition, and other fighting materials; it was equally vital that those products be shielded from the ill effects of moisture and oxygen while in transit or awaiting issue to the armed forces. Unhappily, this was not the case when we first took up the gage of battle. It was to meet wartime requirements that a packaging method was initiated by The Davison Chemical Corporation in which Protek-Sorb silica gel was used effectively as a safeguard against the harmful actions of moisture vapor.

There are materials that call for comparatively simple measures to protect them during transit or in storage, while others require only waterproof wrappings or casings to shield them from rain, melting ice and snow, and salt spray. But there are still others that must be safeguarded from moisture vapor, as distinguished from liquid water. It should be known that many of the so-called waterproof wrappings, excellent

though they may be generally in shedding rain and spray, will permit moisture to work its way through. Further, lumber, fiberboard, dunnage, and many other widely used packaging materials are capable of absorbing much moisture and will to that extent affect the air in contact with the contents. Here is where silica gel comes into the picture and has proved of great aid in shielding products from deterioration no matter what their destination on the Seven Seas.

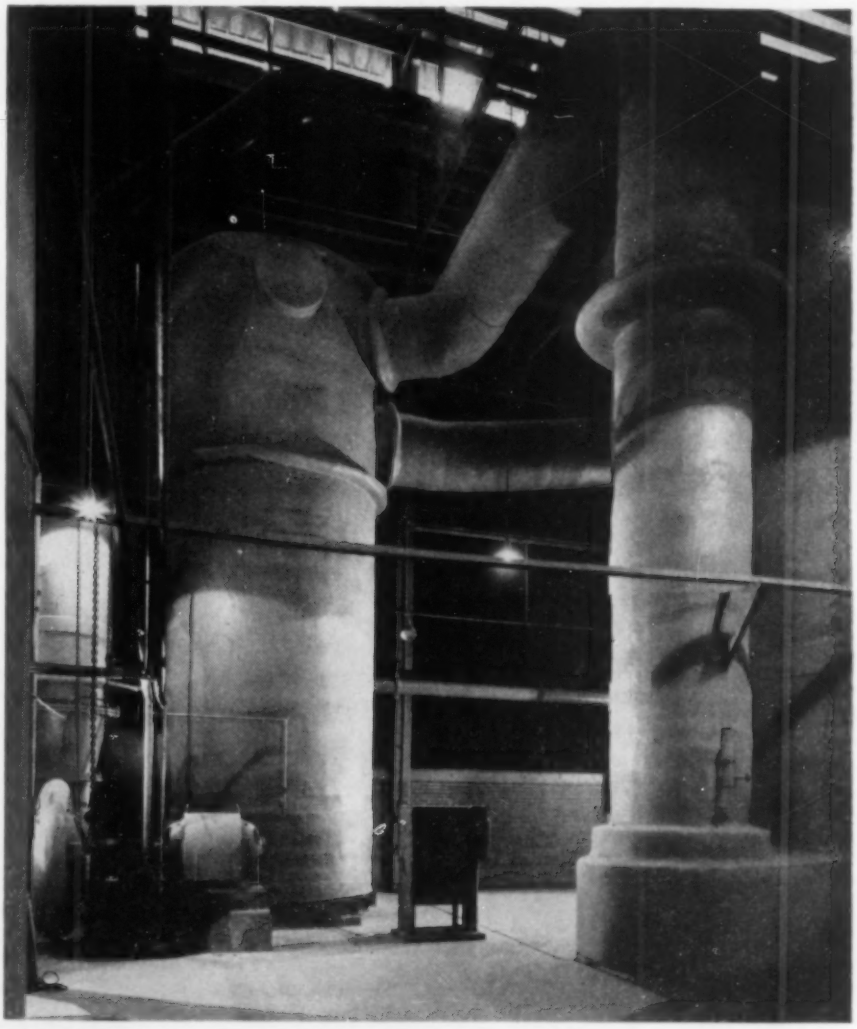
Whether a shipment be crated or boxed to protect it from the elements and from rough handling during loading or unloading, the article itself must be surrounded by a barrier that is proof against moisture vapor and that can be sealed so as to confine the contained air, which will be comparatively small in volume and can be kept safely dry by Protek-Sorb. With the amount of air to be controlled by the desiccant known, reference to an approved table shows just how much should be used in each case to afford protection for any desired length of time. The practice is to put the alert chemical in a number of small bags, holding from 2 ounces to a pound, and to secure them about the article, after which the enveloping barrier of some plastic material is hermetically sealed following partial evacuation. From then on the silica gel will instantly react to any change in the relative humidity of the confined air above the safe measure of 30 percent, and will adsorb the excess moisture vapor and keep the moisture content well below the danger line at which corrosion begins.

The quantity of Protek-Sorb required in any case varies with the characteristic of the product, the type of the container, and the length of time protection may be needed, and may range from as little as 5 grams upward in accordance with the space within the barrier. But it may be asked: What would happen if that covering leaked for any reason and the outside air worked its way into the package unexpectedly? The Davison Chemical Corporation has provided for just such a contingency another form of silica gel, called Tell-Tale, that can be used as a humidity indicator. The Tell-Tale can be placed within the perfectly sealed envelope for recurrent inspection through a little window. It will show by a change in color whether or not all is well within the barrier and to what extent the Protek-Sorb has had to act against the penetration of invading air laden with moisture vapor.

Tell-Tale silica gel is basically the same as Protek-Sorb, except that it is impregnated with cobalt chloride. When activated to the desired degree by heating, it acquires a beautiful deep blue and remains that color unless affected by exposure to moisture. The first change is indicated by paling to lavender; more moisture will produce a lavender-pink hue; and when it attains a clear pink shade an accompanying color chart tells the observer that the Protek-Sorb in the package has reached its limiting capacity to adsorb any more of the moisture present. Watchfulness and prompt location and sealing of the leak in the envelope will prevent this maximum impairment of the Protek-Sorb and will leave it still able to do the work expected of it. In lieu of this course, the package can be opened, replenished with fresh silica gel, and then resealed. Both Protek-Sorb and Tell-Tale can be used repeatedly after reactivation.

Hundreds of manufacturers whose products range from delicate scientific instruments to airplanes and tanks, or from articles of clothing to huge pieces of machinery, are now packaging with Protek-Sorb to reduce losses that might otherwise be caused by moisture while they are in transit or in storage. It is reported that processes for dehydrating bacteriological products and foodstuffs such as milk, eggs, and fruit juices are in course of development and that they promise to be of great value to the nation. In fact, the uses of silica gel are continually on the increase; and the service life of this remarkable material has yet to be determined, inasmuch as the spent chemical may be rejuvenated many times by the application of heat.

The plant of The Davison Chemical Corporation on the shore of Curtis Bay, Maryland, is an immense one and compasses many activities other than that of making silica gel. The mechanical equipment is diversified and includes many pumps, compressors, and blowers that furnish essential air and water for the power plant and the operations throughout the establishment. But none of the other products make quite the same appeal to the imagination as does silica gel, which was evolved in the laboratory during World War I for a single purpose and served the nation and our fighting forces in numerous ways during World War II.



SULPHURIC-ACID PLANT

Sulphuric acid, used in making silica gel, is manufactured in the plant of The Davison Chemical Corporation by burning sulphur to obtain sulphur dioxide and by converting the latter into sulphur trioxide, which unites with water to form the acid. This view shows some of the apparatus used in the burning of the sulphur. At the lower left is a blower that supplies combustion air for the process.

Palletizing of Portland Cement

*R. L. Rhodes**

ALL during the long course of the war we were often reminded that out of it would surely come many developments scientific and practical in application. In the few months since the victorious end of the conflict, we have already seen some of these new things, and more are definitely scheduled for early release. One of the many and vital problems that had to be solved during the emergency was the handling of supplies and equipment in such quantities as had never been dreamed of before. Not only that, but the work had to be done quickly and with the least possible expenditure in man-hours of labor.

The tremendous size of our armed forces, together with their wide deployment, placed a burden upon our transportation facilities for which they were never designed. In fact, the solution of some of the problems involved was so difficult that the heads of many experienced transportation men are still spinning in consequence. One of the answers was the development or, rather, the broadening of the use of pallets by the U. S. Navy for the mechanical handling of large packages, or multiples of packages, of heavy materials—a wartime practice of which we will probably hear much in the future. Ammunition, canned foods, beer, medical supplies, and barbed wire are just a few of the many things that were handled with speed and efficiency by the aid of standard U. S. Navy pallets 4x4 feet by 6 inches in size and by power lift trucks. Products of this kind, in individual cases or packages, had previously been transferred by hand; but, when properly "palletized," 35 or 40 of them could be handled at a time by mechanical means.

For military use, very large quantities of Portland cement were sent out to various theaters of action from the homeland. This heavy, cumbersome material, packed in the conventional paper bag 1 cubic foot in volume and weighing more than 94 pounds each, caused many headaches, as well as backaches, for the men responsible for its handling and rehandling. Upon arrival at a forwarding base, shipments had to be unloaded from railroad cars into motor trucks by hand. Then the trucks had to be unloaded in the same way and the bags stacked in warehouses. Later, when the heavy packages were to be transported overseas, they had to be taken from storage, placed on trucks for hauling to the dock, loaded into the ship's slings, and lowered into the hold. All this rehandling was a manual job. Stowing, too, was back-breaking, and speed of operation at any point along the line certainly was not possible. One can easily picture the many hours of labor that were again required to unload at the port of destination and in moving the cement up to the fighting front or other point of use.

At the U. S. Navy Advance Base Depot at Davisville, R. I., which was operated for the Navy by the George A. Fuller Company and the Merritt Chapman & Scott Corporation, the handling and forwarding of large quantities of Portland cement consumed man-hours at a terrific rate at the start. Then, Clyde C. Roth, project manager for the contractors, began a system of palletizing cement shipments as they were received from the manufacturer. Twenty-five sacks were put on a pallet, making it

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feasible to move the material from the railroad car on by means of power lift trucks. This equipment not only handled but also stacked the loaded pallets three high, which was much higher than men could stack the bags of cement by hand. The available warehouse space was therefore used to much better advantage.

In loading a ship, the pallets, once they were in the hold, were transported and stowed by a power lift truck that had been lowered in advance by the vessel's derrick. The extent to which this heavy handling job was thus speeded up, as well as eased, can be readily appreciated.

Reports have come back from foreign shipping points that the cement carried very well and that definite economies were effected there in addition through the employment of the same system.

It was then decided to eliminate, if possible, the one remaining manual operation and to try out loading the cement on pallets at the mill where it is made and delivering it at the railroad depot ready for immediate handling by lift trucks. There was some doubt as to whether the bags would stay in place on the pallets in the cars, or whether they would slip off owing to the inertia developed by the sudden starts and stops attendant upon heavy freight-train movement.

The Alpha Portland Cement Company offered to test the plan at its No. 4 plant at Martins Creek, Pa. The main purpose of the experiment at that time was to determine the practicability of shipping packaged cement on pallets by rail. The first car was therefore loaded without particular regard to labor-saving. The cement was run into a car in the conventional manner— that is, on hand trucks, seven or eight sacks to the load. Pallets were placed on the car floor, and the bags piled on them, five to the layer and five layers high. A second tier of pallets was then put on top of those stacks and loaded in a similar manner. This was back-breaking labor, what with the close confines of the box car, summer temperatures, and heavy packages which had to be placed precisely and heaved up more than 5 feet in the case of the top layers.

The car was shipped approximately 250 miles to the Davisville base and observed upon arrival by the same men who had supervised its loading. All parties concerned were extremely well pleased with the condition of the lading, as practically no shifting had occurred in transit. It was admitted, however, that better methods would have to be worked out, because no economy in labor had been effected with the first car; the work had merely been transferred from the unloading point to the loading point.

A second experimental car was next loaded at the Alpha Mill. In this case, certain efforts were made to speed up the operation, reduce the man-hours required, and try out several other things that had been learned from the first shipment. The pallets were put on the loading platform directly at the end of the conveyor that brings the bags of cement from the packing machines. Two men guided the sacks on to the pallet and placed them in a manner so that each successive layer would, to some extent, hold the one below it more securely. A power lift truck then picked up the pallet with its burden, ran it into the box car, and put it in position. While this was being done, another pallet was stationed at the conveyor and loaded so that it would be ready for the lift truck by the time it returned. The addition of this mechanical device to the car-loading facilities proved the idea to be thoroughly practicable. With a few minor changes that were worked out later, the system was used successfully by several producers in exporting large quantities of cement.

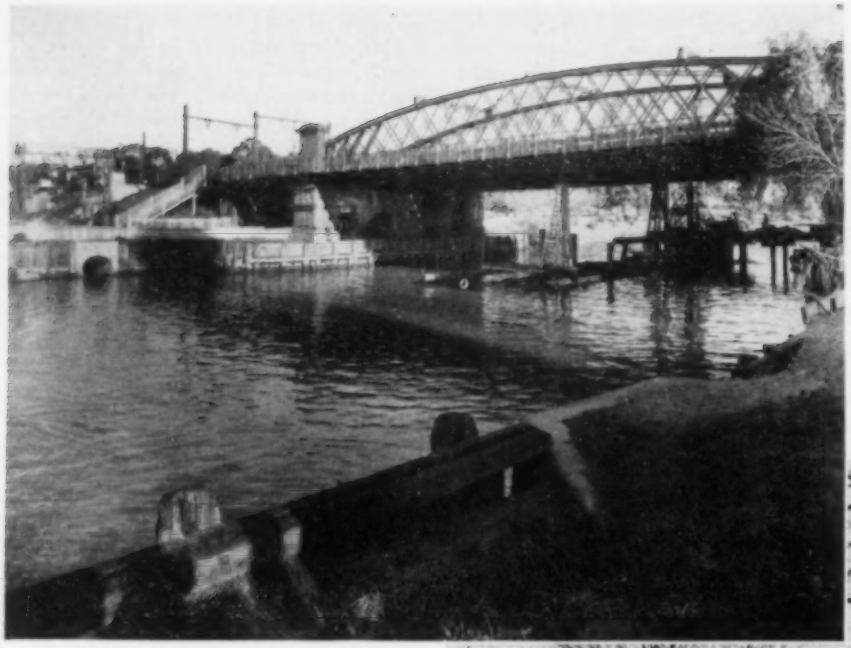
Through mill palletizing, the operation of unloading was made so much easier and so much more rapid that 25 to 30 cars could be handled in the same period in which only a few had posed a problem, thus effectually removing a bottleneck.

MAKING UP AND LOADING PALLETS AT THE MILL

The view at the top-left shows the loading station at the delivery end of the conveyor, with 25 bags of cement (2350 pounds) arranged in five layers of five bags each on a skid or pallet. A power lift truck stands ready to move the load as a unit. In the center picture the lift truck is placing the laden pallet in a boxcar. Surplus space in the center is taken up by inserting a row of skids, upended, the length of the car. Below is seen one end of the car half loaded. Note the careful positioning of the bags to lessen the possibility of their shifting while in transit.

A New Railway Bridge in Australia

Ian McGregor



OLD BRIDGES AND NEW WORK

The existing structures are so close together that they appear as one in the top picture. Actually, the near bridge, with horizontal, latticed girders, was built a quarter-century earlier than the far span having arched top chords. In the river, piling is being driven for a cofferdam to surround the site of the north river pier for the replacement structure. Below is another view of the old bridges and, at the left, the abutment and land pier for the south end of the new crossing. After the Yarra is widened and the roadway straightened the latter will pass between these two concrete structures.

ABOUT three miles southeast of Melbourne and just north of the South Yarra Station, the Victorian Railways is building the Cremorne Railway Bridge across the River Yarra. The structure is to replace two older bridges which are very much below present standards of loading and traffic requirements. The old crossings are of the wrought-iron-and-steel, latticed-girder type of construction and rest on bluestone piers and abutments. They consist, respectively, of one central 148-foot span and two spans, each 41 feet long, over the roads on opposite sides of the river.

The first of the older bridges was erected in 1860 to carry a suburban double-track, steam train service and was fortunately built so that each track can be torn up separately. In this structure there are three lines of girders, two outside and a common central girder. Thus, it is necessary only to remove one outside girder to demolish one of the tracks, the second line still being able to support its full quota of traffic. The second bridge, to the east and immediately adjacent to the earlier span, was constructed in 1884 and has two tracks. It was built by David Munro of Melbourne, and also is of the latticed-girder type, having an arched top chord. For the 1860 structure, parallel top and bottom chords were adopted.

The two lines, electrified in 1920, have carried all the railway traffic of the southeastern suburbs of Melbourne and have materially influenced the city's development in that direction. In fact, probably one-third of Melbourne's total suburban rail traffic passes over the bridges, there being a regular daily movement of 572 trains—508 local passenger trains, ten local freights, and 54 long-distance passenger and freight trains. Although four tracks from the Melbourne Central Suburban Railway Station at Flinders Street cross the bridges, six extend from them to South Yarra. There, two branch off to Sandringham and four continue to Caulfield, where one of Melbourne's major racecourses is situated. When completed, the new structure will carry six tracks through to Flinders Street and so effect a necessary increase in the traffic capacities of the lines serving the eastern suburbs.

Apart from rail transportation, a considerable volume of road traffic moves in Alexandra Avenue, which flanks the south bank of the Yarra and passes under the bridges at South Yarra. At the present time there is an awkward double bend in the highway where it runs beneath those structures, and this involves straightening the road and widening the river at that point. The latter is somewhat constricted there during periods of maximum flow, which generally coincides with the spring rains in September and the melting snows from the mountains at the stream's source. Flood stages (generally at about 10-year intervals) have caused high water in the more easterly suburbs and have frequently inundated Melbourne's championship tennis courts at Kooyong, where many a Davis Cup Final has been played in years gone by. Another phase of the project will be the improvement

and remaking of the highway along the north side of the Yarra. It will also pass under the bridge, considerably relieving congestion.

The 1884 span has a narrow footway permitting pedestrians to cross the river, and this feature will be retained in the new bridge. The superstructure of the latter is to be made up of standard riveted-type plate girders and of a concrete deck. There will be five spans. Each of the two side spans, extending from abutments to piers standing on shore, will be 80 feet long and will be carried over the two river-bank roads—Alexandra Avenue and Harcourt Parade. The three central spans will be 96 feet each, making a total length from abutment to abutment of 448 feet. The piers and abutments will be of mass concrete with some reinforcement, the piers being supported by concrete pillars resting on Silurian mudstone about 50 feet below sea level.

At the present time, the south abutment has been poured with the exception of one wing wall and to date contains 4500 tons of concrete, with about 380 tons still to be placed in the wing wall. As much of the material as possible was poured continuously, each pour generally lasting 24-36 hours during which 1V and 2V pneumatic vibrators operated continually. Some of the pours recorded totaled 960 tons, 530 tons, 380 tons, etc.

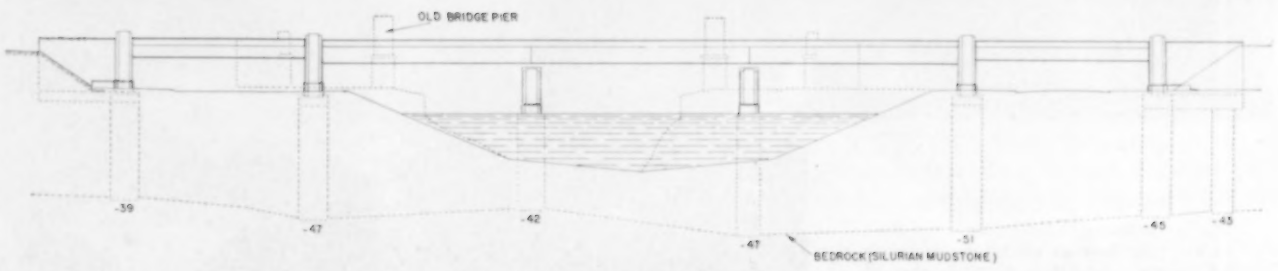
To insure a smooth finish without further decoration, squares of plywood were placed inside the forms. This was not as effective as had been expected, in that air bubbles were trapped between the forms and the concrete and could not escape, leaving pinholes in the surface. Apart from this, the general appearance of the concrete was good. But no pinholes occur when tongue-and-grooved flooring is used for the forms, for there is apparently enough space between the boards to allow the air to escape and the fit is sufficiently close so that there is practically no sign of junction. Rubbing down with an old felt hat, however, has given a satisfactory finish to the external surfaces of the concrete poured so far, and no further treatment will be required.

An interesting sidelight on the heat generated during the setting period of concrete was revealed as the result of a provision—a 6x4-foot space 8 feet deep—that was made to reduce weight at a particular point in the abutment. Three days after pouring, one of the workmen entered this hole for some purpose, but he lost no time in emerging because the temperature in it was so high that he would undoubtedly have collapsed in a short while owing to the heat concentrated there.

The method of building the bridge, in brief, is to place the concrete piers and abutments in excavations below the present tracks and to pour the river piers in protecting cofferdams. The first section will be erected on the west side, clear of the 1860 bridge. Then the west half of that old structure will be removed to provide for the second section of the new bridge, and so on, progressively switching the tracks to keep four in service as at present and until six tracks are ultimately in operation.

At this writing, two land piers and the south abutment have been poured and the excavations are complete for the north abutment. In addition, much sheet piling has been sunk and digging has started on the foundations for one of the piers in the stream. In excavating for the south abutment, a considerable amount of seepage occurred, and this was kept in check by Nos. 25 and 35 air-operated sump pumps. In the case of the north abutment, on the other hand, the work was almost entirely dry, and 6x2-inch timber sheeting was driven by CC80 pneumatic hand-held pile drivers. Sheet steel piling was used for the cofferdam for the river pier and was sunk steadily well into the mud with the exception of the final locking piece, which encountered increased resistance when it still had about a foot to go. Then it suddenly listed badly and water began to pour through. This necessitated withdrawing the member and investigating the obstruction.

It was found that the sheet steel had cut through a 15-inch-diameter wooden pile, which was evidently part of the substructure of the old bridge and was not shown on any of the old plans still avail-



THE NEW BRIDGE

An artist's conception of the structure now being erected and as viewed from the west is shown at the top. The drawing is a west elevation and gives the locations and depths below sea level of the piers and abutments of the new bridge. The abutments of the existing structures and the present positions of the river banks are indicated by dotted lines. The new crossing will have a total length of 448 feet.

able. The pile had been split straight down the center; but, unfortunately, two heavy bolts, holding a couple of cradle timbers at the bottom, had cut the sheet as cleanly as though a pair of shears had done it. If the obstruction had been as little as 6 inches farther upstream, this hitch in the work would have been avoided. Incidentally, this pile, the top 8 or 10 feet of which was above mud level—underwater—was in perfect condition after 40 years of submergence. It is believed to have been Stringybark Messmate, an Australian hardwood, for which the Standards Association of Australia has adopted the reference name of *Eucalyptus Obliqua*. The cofferdam has been completed and dewatering is progressing by means of a 6-inch vertical, electrically driven centrifugal pump aided by air-operated sump pumps.

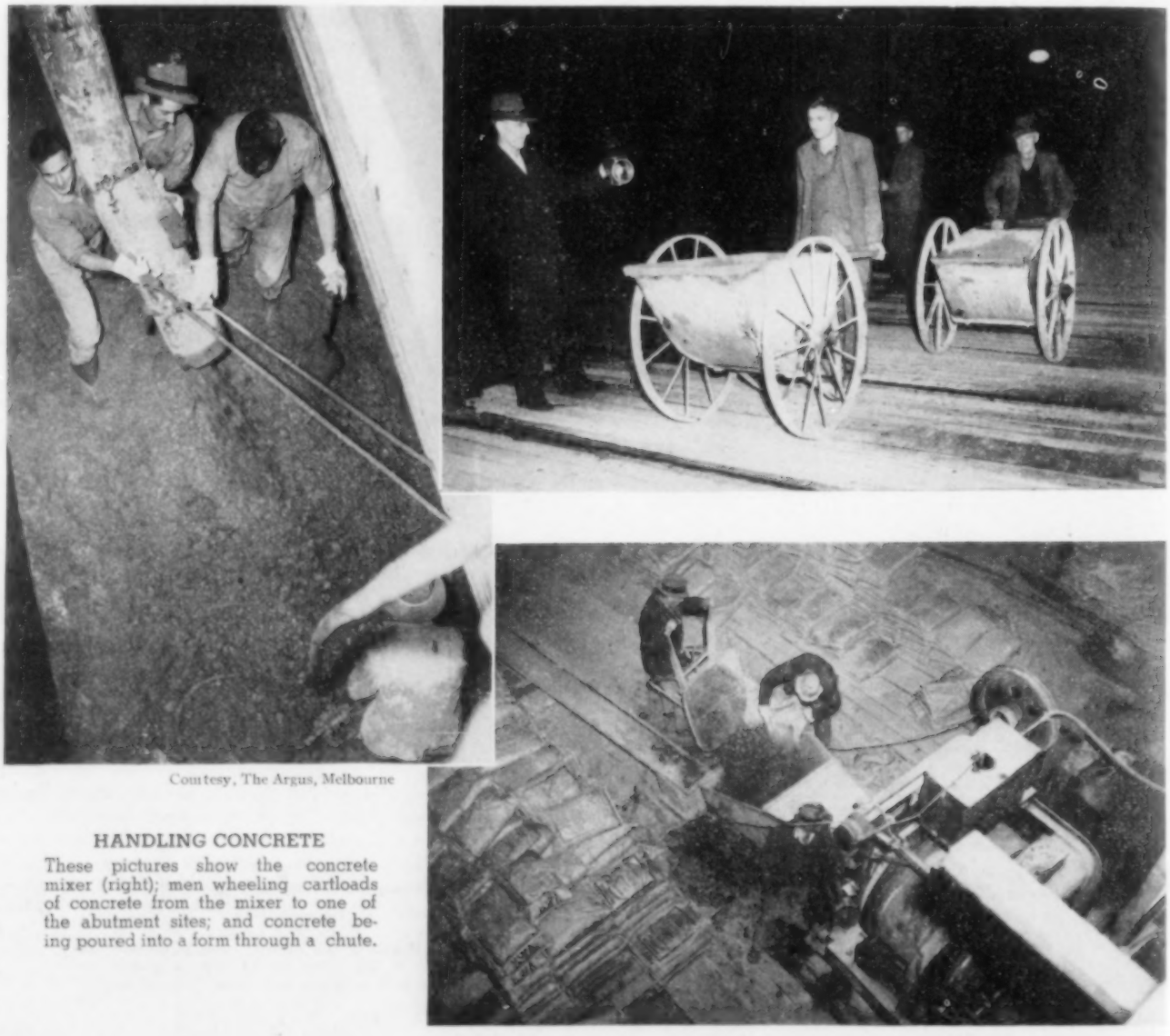
Much compressed air is needed on the job, and in addition to the pneumatic equipment already mentioned there are such air-operated tools as wood borers, saws, impact wrenches, paving breakers, and Jackhamers using Jackrods and Jackbits. The compressor plant consists of six portables: four Model 100 gasoline-engine units, each with a capacity of approximately 80 cfm., and two 160-cfm. diesel machines. Two Britstand concrete mixers handle the concrete, and four International gasoline-driven hoists serve to do the lifting and hauling. Ample 415-volt, 3-phase, 50-cycle current is available and is drawn from the Victorian State Electricity Commission's Metropolitan Distribution System.

The estimated cost of the Cremorne Railway Bridge is 335,000 pounds—$1,083,725 at the present rate of exchange—and its construction will provide employment for a period of from two to three years for about 150 men, including laborers, rail layers, and several classes of skilled workers. While the war was still in progress, it was necessary to slow down or postpone other projects that were not so urgent in order to obtain the required number of workmen. But that condition no longer prevails.

Showers, changerooms, and a dining room have been erected on the bank of the Yarra, and rooms with a fireplace of novel design have also been built for the comfort of shift workers and as shelters during bad weather. A coke heating system provides hot water, which considerably increases the popularity of the showers. It is doubtful whether they are needed on a job such as this near the employees' homes; but for men working on a river site, where they are liable to get wet and chilled, they are probably worth while even if not used to their maximum capacity. In any case, the extent to which these facilities are utilized is being watched as a guide for the future.

The bridge is being constructed by the Victorian Railways Department, and shop fabrication of the steel work is being done by Charles Ruwolt Pty., Ltd , of Melbourne.

The writer wishes to thank the Victorian Railways authorities for permission to publish this article, for the assistance given him in obtaining the information, and for the drawing and some of the photographs reproduced.



Courtesy, The Argus, Melbourne

HANDLING CONCRETE

These pictures show the concrete mixer (right); men wheeling cartloads of concrete from the mixer to one of the abutment sites; and concrete being poured into a form through a chute.

Photo Worcester Salt Co.

THE LAST SUPPER

A section of the famous painting by Leonardo da Vinci showing Judas Iscariot seated at the table and clutching in his hand the bag supposedly containing the money given him for his betrayal of Jesus. In front of him is an overturned saltcellar, recognition by the artist of the superstition that evil consequences follow the spilling of salt.

Salt, Our Most Useful Mineral

Historic Commodity Essential to Foods, Agriculture, and Industries

E. B. Tustin, Jr.

SALT is the most common mineral in existence, but do you know of one that is more useful? Since early times it has been synonymous with value and worthiness, as witnessed by the Biblical statement, "Ye are the salt of the earth" (Matthew 5:13). To primitive peoples it represented something that was not perishable and that would keep foods from spoiling; hence the sacred significance with which it was endowed. We find that whenever salt is named in the Bible it is done so in language stamping it as a most vital element. Especially do we notice this in directions for religious services. When Elisha sweetened the waters of Jericho he cast salt into them, thus illustrating its purifying properties, for he said, "I have healed these waters" (II Kings 11).

As a Covenant

In countries of the East it is a time-honored custom to place salt before strangers as a token and pledge of friendship and good will. And the practice of using salt in confirmation of an oath goes back to antiquity, as shown in the following passage from an ode of the Greek lyric poet Archilochus, who flourished 2000 years ago:

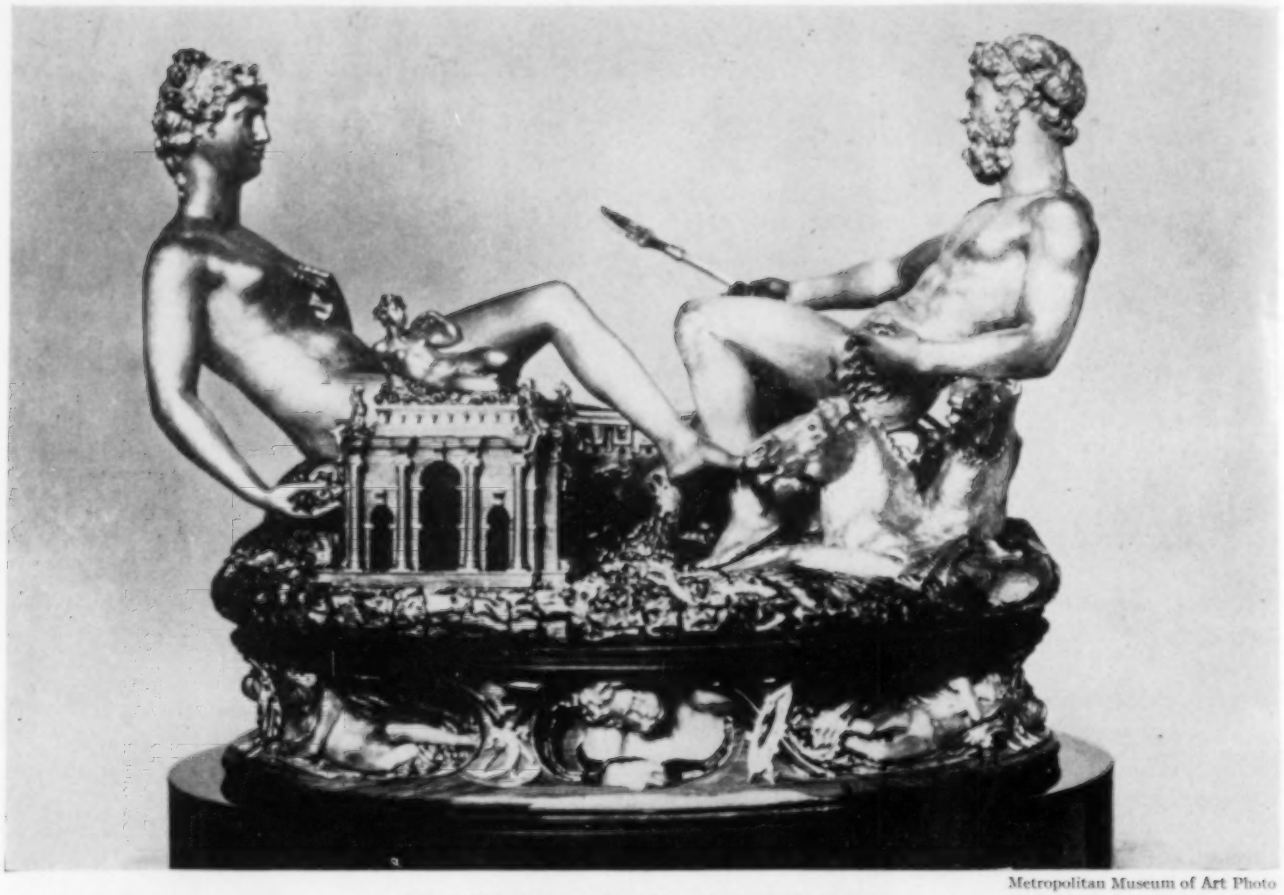
"Thou hast broken the solemn oath
And hast disgraced the salt and the table."

Even at the present time Arabian princes

COMPRESSED air is used for several purposes at the Worcester Salt Company's plant, Silver Springs, N.Y. Its chief function is to lift brine formed by dissolving rock salt located about 2200 feet underground. This is accomplished by a piping arrangement made up, briefly, as follows:

A pipe, extending to a depth of about 600 feet below the surface, serves as a well casing. Within the latter is a pipe that reaches to the bottom of the salt cavity. This is the brine-delivery pipe inside of which, in turn, is another pipe down which compressed air is forced to raise the brine to the surface of the ground.

Compressed air is also applied in other ways. For example, it is used for mixing brine in large treating tanks. There is an air lift for pumping liquids from one department to another, as well as numerous air-operated tools that perform various services. And in the packaging departments, empty cardboard containers are conveyed pneumatically.



Metropolitan Museum of Art Photo

CELLINI'S MASTERPIECE FOR A MONARCH

Considered one of the world's finest art creations, this solid-gold saltcellar was made about 1540 by Benvenuto Cellini, the Italian master silversmith, for King Francis I of France at the request of the Cardinal of Ferrara, who obtained the artist's release from prison and took him into his home. Cellini fashioned the piece entirely with a chisel, and in his autobiography he described it as follows:

"I first laid down an oval framework, considerably longer than half a cubit (a cubit was approximately 17½ inches)—almost two-thirds in fact; and upon this ground, wishing to suggest the interminglement of land and ocean, I modeled two figures, considerably taller than a palm, which were seated with their legs interlaced, suggesting those lengthier branches of the sea which run up into the continents. The sea was a man, and in his hand I placed a ship, elaborately wrought in all its details, and well adapted to hold a quantity of salt. In his right hand he held a trident. Below him were his four sea horses, fashioned like our horses from the head to the front hoofs; all the rest of their body, from the middle backwards, resembling a fish, and the tails of these creatures were agreeably interwoven. The earth I fashioned like a woman, with all the beauty of form, the grace, and charm of which my art was capable. She had a richly decorated temple firmly based upon the ground at one side; and here her hand rested. This I intended to receive the pepper. In her other hand I put a cornucopia, overflowing with all the natural treasures I could think of. Below this goddess, in the part which represented earth, I collected the fairest animals that haunt our globe. In the quarter presided over by the deity of the ocean, I fashioned such choice kinds of fishes and shells as could properly be displayed in that small space. What remained of the oval, I filled in with luxuriant ornamentation."

According to last reports, prior to the war, this saltcellar was in Vienna.

are wont to ratify an alliance by sprinkling salt upon bread, exclaiming, "I am the friend of thy friends, and the enemy of thine enemies." During the Indian mutiny of 1857 the chief motive of self-restraint among the sepoys was the fact that they had sworn by their salt to be loyal to the English queen.

Superstitions

The widespread notion that the spilling of salt will bring evil consequences in its train is probably attributable to its sacred character in early times when anyone having the misfortune to spill some was supposed to incur the anger of all good spirits. Leonardo da Vinci evidently had this superstition in mind when he portrayed an overturned saltcellar in front of Judas in his painting, "The Last Supper." This belief in the sacred properties of salt has persisted through the ages.

In Scotland the mineral was in high repute as a charm, and the salt box was the first chattel to be removed to a new dwelling. When Robert Burns, in the year 1789, was about to occupy a new house at Ellisland, he was escorted on his way along the banks of the River Nith by a procession of relatives in whose midst was carried a bowl of salt resting on the family Bible. Peculiar ideas about its magical qualities were common among the uneducated in this country. In some regions a new tenant would not move into a furnished house until all the objects in it had been thoroughly salted with a view to the destruction of witch germs.

As Money

It is a fact that Roman soldiers were given a percentage of their pay in the form of salt, from which comes our modern word "salary" and the expression "worth his salt." Among the ancient Chinese it was considered second in value to gold only, and it held an important place in the monetary system of the Great Moguls. Marco Polo, back in the thirteenth century, wrote of flat cakes of salt which bore the stamp of the mighty Khan and which served as money in Tibet. Even today salt is used for that purpose in certain parts of Africa, Mexico, and the South Sea Islands.

When the followers of Mussolini invaded Ethiopia the native hunters refused to accept Italian currency in ex-

change for skins, but insisted upon being paid in coin-shaped disks of salt. Right here in America, each member of the Onondaga Tribe of Indians still receives from New York State, in accordance with an old treaty, an annual payment of salt as part compensation for ceding 7300 acres of land to it in 1913.

The Saltcellar

To the Romans, salt was a sacred article of food, and it was a matter of religious principle with them to see that no other dish was set upon the table before salt was in its place. With the peasant, a shell served as a receptacle, but at the repast of the wealthy citizen a silver saltcellar, which was usually an heirloom, graced the middle of the board. This custom also prevailed in England in early times.

Medieval saltcellars were often elaborate pieces of craftsmanship, and until the end of the seventeenth century the rank of the guests at a banquet was indicated by their seating with reference to the massive saltcellar. At the head of the table "above the salt," sat the host and his more distinguished guests. The less exalted were "below the salt." In the eleventh century the laws of King Canute provided that any person sitting at a feast above the position to which he was entitled should be "pelted out of his place by bones at the discretion of the company." Those were the days when meat was in abundance.

In Warfare

History is replete with illustrations of the economic pressure exerted on peoples because of a lack of salt—it has forced them to make war, to build ships, roads, and cities, and to enter into commerce on land and sea. It has also played a strategic part in great military engagements. Napoleon's soldiers on the ill-fated retreat from Moscow died by the thousands as the result of wounds whose failure to heal was attributed to prolonged deprivation of salt. The same circumstances were reported during the Paraguayan War of 1874; and in our own country, during the Civil War, one of the principal purposes of a Union campaign into Virginia was to capture from the Confederacy its chief source of salt located at Saltville. Nowadays it is of vital importance to the welfare of the armed forces as well as to civilians in industry, and millions of salt tablets are consumed by them to replace the salt lost through perspiration and thus help ward off fatigue.

How Salt Is Obtained

Old manuscripts bear testimony to the fact that China obtained salt some 5000 years ago by boiling and evaporating the ash from seaweeds. Scarcely 100 years back, our own Indian tribes supplied themselves in much the same way with this essential product—those living near the ocean evaporated sea water in open trenches while those inland boiled and evaporated the brine from springs to which buffalo and deer were wont to go. Early American settlers in the interior underwent great perils and hardships to provide themselves with salt. As might be expected, it was an expensive commodity, and at the time of the War of 1812 cost $5 a bushel.

Until 1886 there was little change in the age-old method of manufacturing salt. Then Joseph Duncan, an American, started a company at Silver Springs, N. Y., employing a revolutionary process—the vacuum-pan process—that is in general use today and produces a uniformly grained salt of high purity. The source of supply is rock salt lying about 2200 feet underground. Wells are bored and water is piped down to the deposit, the resulting brine being pumped up, filtered, and purified. After evaporation, the salt is drawn off and conveyed to driers. It is then screened to separate crystals of different sizes used for various food and industrial purposes.

Uses

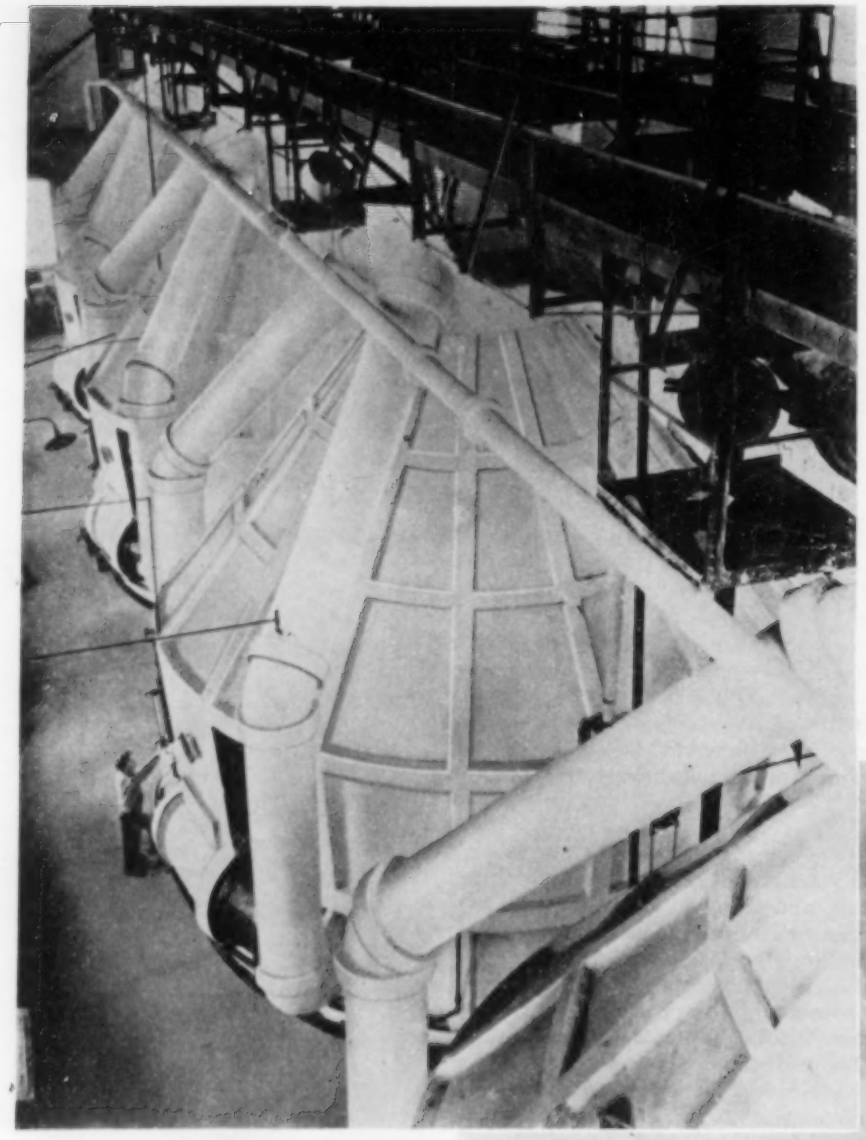
The more civilization has progressed, the more demand there has been for salt, and today in excess of 4,000,000 tons are required annually for the home and for a great number of farm and industrial applications. Three hundred thousand tons are consumed each year just in curing hides and skins for leather. The discovery of rayon struck a blow at the Japanese silk industry, and rayon is produced with the aid of caustic soda, which is obtained from sodium chloride. Salt solutions have long been used as a gargle, and sodium chloride is an important constituent of some dentifrices. Chemicals from salt are now needed to make the new "sulfa" drugs, vitamins, and other pharmaceuticals.

According to Dr. Morris Fishbein, Editor of the *Journal of the American Medical Association and Hygeia*, "Sodium chloride or common salt probably ranks first among all the salts in the human body, both in quantity and in its value in the body's nutrition." It is estimated that adults need about ½ ounce per day, or 12 pounds a year, to enable the various glands to hold the amount of water they require for proper functioning. Sodium chloride is also the source of an important component of gastric juices in the bodies of both humans and animals. Upon receiving salt, the stomach changes the former's chloride component into hydrochloric acid in order to digest food. The body divides the mineral into its chemical constituents with the greatest of ease, but it takes elaborate equipment to do the same thing industrially.

Electricity is the key to the decomposition of salt crystals. When a strong current is passed through molten sodium chloride the hot mass is separated into sodium—a silvery white metal—and the greenish-yellow gas chlorine. Both elements have a wide field of application in industry. Sodium has been employed for many years in the manufacture of dyes, insecticides, and photographic materials, and more recently in making tetraethyl lead for aviation gasoline. The operation of airplanes at the terrific speeds at which they now fly is facilitated by sodium in the valve stems. By this means the heat from the engine is conducted rapidly to the radiating system and danger of overheating is minimized. Chlorine is equally adaptable. Added

HOURGLASS SALTCELLAR

This exquisitely wrought silver-gilt piece is 14½ inches high and was produced about 1490 by a silversmith whose identity is no longer known. It was presented to New College, Oxford University, England, in 1493 by Walter Hill, who was warden of the institution from 1475 to 1494. Our picture is a reproduction of a photograph of an electroplate replica of the cellar that is on display in the Metropolitan Museum of Art, New York City.



PRODUCING AND REFINING SALT BRINE

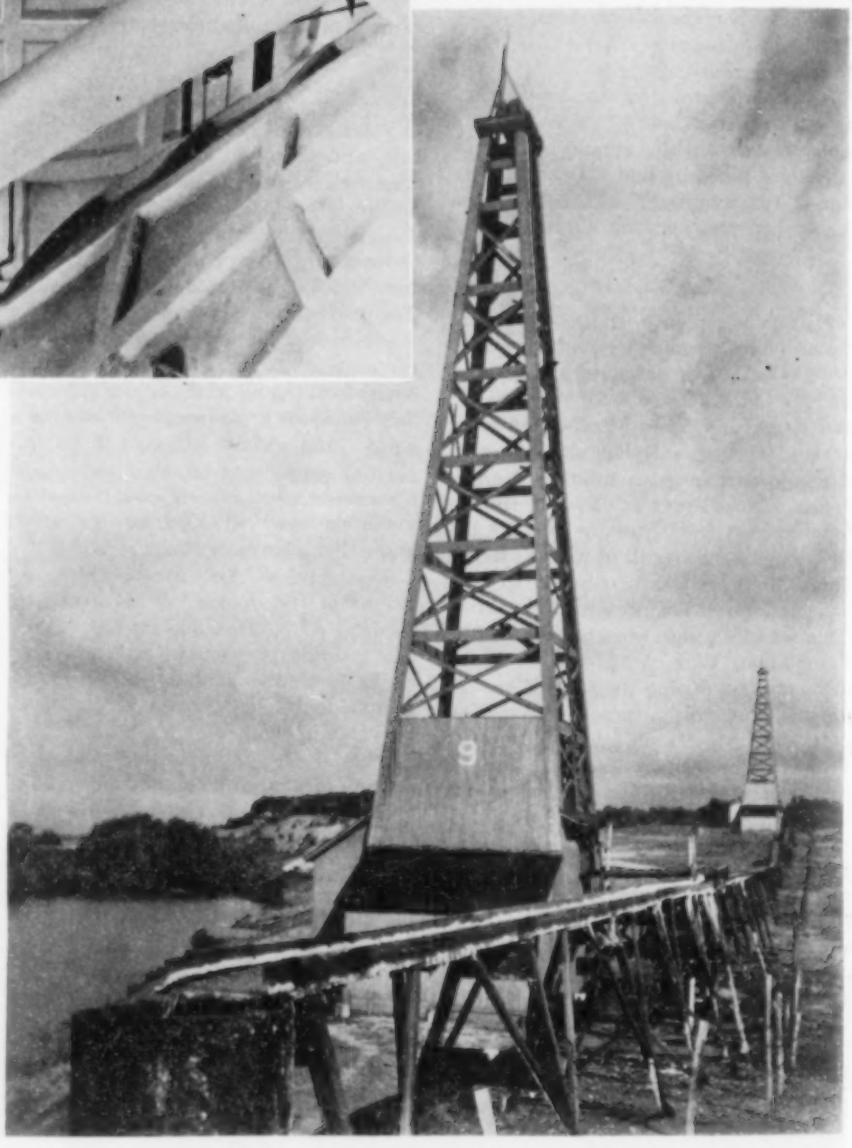
At the Worcester Salt Company's works at Silver Springs, N. Y., water is piped down derrick-topped wells to salt deposits nearly half a mile underground. There a brine is formed, and this is pumped to the surface and evaporated to extract the salt. The view above shows the huge vacuum-pan evaporators, where the brine is passed successively through a series of four tanks under an increasing vacuum. Evaporative heat is supplied by steam.

to drinking water in small quantities, it has saved thousands of lives by destroying bacteria.

The wearing parts of tanks, trucks, and planes could not have taken the terrific punishment they did if the pinions and gear surfaces had not been case-hardened in a bath containing molten sodium cyanide, another member of the salt family, as are cyanides of copper and zinc. All these, because copper and brass shortages led to the use of steel shell cases, were required to plate the latter with copper or zinc to give them smooth nonrusting surfaces. Likewise from salt comes sodium peroxide, with which millions of yards of cotton fabrics for the armed forces were bleached.

From hydrochloric acid—another salt derivative—and acetylene gas comes Neoprene, which is referred to by the Baruch Committee as the "one synthetic material of a quality to be the full equivalent of natural rubber for combat and heavy duty tires." But Neoprene has many applications, including the coating of fabrics for blimps. Other products obtained from salt are the chlorinated hydrocarbons. These are needed in enormous quantities to clean the metal parts that go into tanks, trucks, ships, planes, and guns. Some of these compounds enter into the making of smoke screens used in warfare and are constituents in fire-extinguisher fluids, refrigerants, and anesthetics.

This list of products is far from complete, but it gives a fair idea of the extent to which man is dependent upon salt. And yet research chemists are finding still more uses for this commonest and most adaptable of minerals.



Note of Clarification on Hydroponics

Dr. W. F. Gericke

FLOWERS AND VEGETABLES

The author and Mrs. Gericke are pictured above with a bed of tuberous begonias grown by hydroponics at their home in Berkeley, Calif. The other view shows Doctor Gericke with some of the 100 heads of cabbage he produced in a 3x25-foot bed.

THE June, 1945, issue of COMPRESSED AIR MAGAZINE contains an article and an editorial on hydroponics, the method of growing plants without soil. In the interest of this development and also that of the public, the writer, appreciative of these discussions, desires, however, to point out certain widely current misconceptions concerning the principles and applications of this method of raising crops. These misconceptions have done great harm to hydroponics in its crucial formative period and thus delayed its establishment—its wide use.

Hydroponics means "water working" or, better expressed, "the workings of the water." These workings are manifested in the character of the roots which plants produce when they are growing suspended in water containing nutrients, as distinguished from those growing in soil. The word was originated to convey the idea that the role played by water in crop production without soil is analogous to that performed by the solid matter of the soil in agriculture. Consequently, the use of the term hydroponics as applied to the method described in the aforementioned article—*Gardens Without Soil*—is not in harmony with the etymology of the word. This can be readily appreciated, as the chemicals added to the water in hydroponics substitute only for the nutrients in fertile soils that constitute on an average 0.001 of 1 percent of the weight of the ground in which roots grow.

The moisture of the soil which plants absorb has its counterpart in hydroponics and is that part of the water in the basin which plants absorb. When soil or solid matter is not used to grow crops, a substitute must be found that will serve as the habitation for the roots. In hydroponics this is the part of the water in the basin that plants do not absorb. The physical properties of the unabsorbed water create the scientific foundation for the method of crop production without soil. Similarly, as agriculture is based on the dynamics or physical properties of solid matter which provides habitation for the roots of plants and supplies them with water and nutrients, so likewise is hydroponics based on the dynamics or physical properties of fluids that provide habitation for the roots and from which they obtain water and nutrients. Indispensable as nutrients are, they function merely as the product of a system and are not the physical foundation on which either agriculture or hydroponics is based.

No one would contend that soil is composed of water and nutrients only and that these are the materials which make soil of any part of the earth in which land plants grow. The very essence of soil, land, ground, or earth is solid matter, and it is immaterial whether these are described as sand, cinders, or gravel. These classifications do not change their basic natures, and they are soil, land, ground, etc., in the generic sense in which these terms have always been used. Thus the question, whether a plant is grown by soil or soilless culture, resolves itself into a consideration not of the manner in which nutrients are supplied but rather of the physical properties of the states of matter, solids or fluids, which serve as habitation for the roots.

Fluids cannot provide anchorage, fixity of position, resistance to penetration, porosity, moisture-saturated atmosphere, differentials in temperature, and other physical conditions inherent in porous solids that have controlled or influenced the evolution of land plants and thereby determined the characteristics of the roots of the various species. Therefore, the roots of all species grown by hydroponics differ from those of their kind growing in soil. The implications of these changes, which express the dynamics of water, are profound and far reaching. A new universe for the cultivation of land plants has come to light in hydroponics.

Depending upon the effect of water on the root growth of plants, the yield and quality of certain crops produced by hydroponics are superior to those obtained by agriculture. But in the case of other species, where the root growth is changed too radically by water, yield and quality of hydroponic crops are inferior to those of agriculture. An idea of the productive potentiality of hydroponics is conveyed by experimental demonstrations which have shown that potato yields run at the rate of 1500 to 2000 bushels per acre. A considerable area of the United States has a climate that will permit the growing of three crops of potatoes a year, with an aggregate yield of about 4000 bushels per

acre. But throughout the major part of the country the climate is such that two crops, totaling around 3000 bushels, may be harvested. The average annual yield of potatoes in the United States is 130 bushels per acre. The high production by hydroponics can be further increased by raising other species of crops with the potatoes, which is either impossible or impracticable in soil.

The cost of potato production by hydroponics is less than that by agriculture. A similar situation holds for other vegetables. Crops harvested as dry matter such as corn and wheat, also forage and fiber crops, cannot be cultivated economically by hydroponics in competition with agriculture. Orchard trees cannot be grown to full size by this method, as the physical properties of water preclude the development of a root system commensurate with the requirements of a large trunk. All trees become dwarfed in hydroponics. This is of great value in the growing of small trees for decorative purposes.

The economic and sociologic implications of the ultimate large-scale use of hydroponics, which presumably is not far distant, cannot be otherwise than profound and far-reaching in view of yields of the aforementioned magnitude. The consequences of its wide application would rank in the flow of history with the events that followed the discovery of new continents. The extent of the possible domain of hydroponics is the entire earth's surface where the climate is favorable to the growth of vegetation and where there is sufficient usable water. All other elements of fertility normally inherent in soil can be supplied. Thus the world's area suitable for hydroponics is much larger than the area of arable land. Terrain not fit for agriculture can be used for hydroponics.

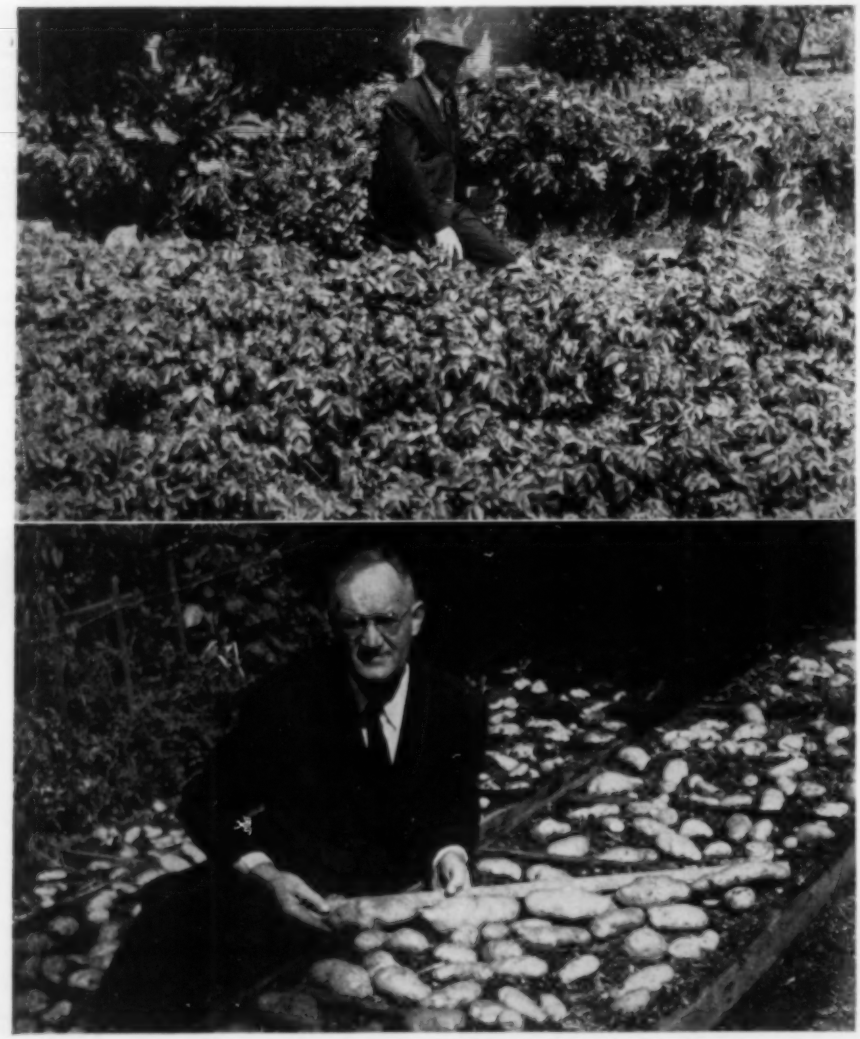
The great productive capacity of hydroponics for certain crops arises from the fact that the elimination of solid matter as the home for the roots increases the space available for water three to four times and that available for air two to three times. Any desired amount of nutrients can be added to the water, and any desired concentration can be maintained. For these reasons plants can be set much closer together in hydroponics than is possible in soil, resulting in correspondingly greater yields.

The equipment required to grow plants without soil is much simpler and more economical than that needed to cultivate them in beds of sand or gravel to which nutrient solutions must be applied frequently. There are some plants that will thrive better when their roots are embedded in sand or gravel than when they are suspended in the water of hydroponics, and the method described in *Gardens Without Soil* has a definite field of application. It was used in developing hydroponics, and the author demonstrated its commercial practicability for some crops before the feasibility of crop production without soil was demonstrated in 1929. The plants mentioned in the article can be grown by hydroponics without any of the equipment employed for drainage and for pumping the solution back to the beds.

Failure to recognize the fundamental relations which exist between fluids and porous solids on root growth of plants has led to various misconceptions concerning the use and operation of hydroponics. The originator of the method has never made it a practice to bubble air through the solution for purposes of aeration, nor have practical growers found that to be necessary. Further, the importance attached to maintaining a specified pH value of the nutrient solution has been markedly overstated.

The concept that the nutrient solution is a specific formula, in the sense in which the term is used in chemistry and pharmacy, has not been borne out in practical hydroponics. Indispensable as nutrients are, their relative importance in the methods and procedures of hydroponics has been unduly placed in the foreground because of the fact that the relative importance of the nonnutritive substitutes for the soil has been so woefully underestimated in portraying crop production without soil. Mastery of hydroponics comes with the realization that water changes the roots of plants—causes them to differ from their soil types—and that the substitutes for the nonnutritive portion of the soil must be made to meet the requirements of the changed root system. Once the grower knows how to do this he will have no difficulty in providing the mineral needs of plants.

Hydroponics provides a new field in which compressed air will have various applications as a means of control and of facility of operation.



POTATOES DO WELL

Potatoes growing in basins terraced into a hillside having a 40 percent slope are pictured at the top. The basins are 3x25 feet in dimensions and vary in depth from 3 to 8 inches. Best yields obtained have been at the rate of 2000 bushels per acre. Three crops can be raised each year in the Berkeley climate. Five potatoes, placed end to end and measuring 36 inches, are shown below.

"Fewclothes"

W. S. Powell

"GO 'way and don't mess wit' me. I'm a bad man!" "Fewclothes," whose real name was Dan Chains, in many respects resembles John Henry as a character in the folklore of the mountains and figures prominently in the legends that circulate by word of mouth throughout the coal fields of southern West Virginia. John Henry is most often described as a burly Negro, of great stature and prodigious strength, who was employed as a steel driver on the Big Bend Tunnel of the Chesapeake & Ohio Railroad near White Sulphur Springs around the year 1870.

It was during that period that steam drills were being introduced and experimented with, and the tunnel contractors decided to give them a trial at one of the headings. John Henry heard of the plan, scoffed at the idea, and boasted that he could sink more steel in rock than any steam drill in existence. So a contest was arranged that was to last 35 minutes, and if John Henry beat the machine he was to receive $100.

When the race was over the hefty Negro had won the bet, having drilled two holes, each 7 feet deep, while the drill had sunk the steel to a depth of only 9 feet. John Henry proudly accepted his winnings and went home. After his evening meal he complained of a pain in his head and sought his bed. The next morning he was dead, the exertion having caused a blood vessel to burst in his head. There are countless variations of the story in prose and verse, some of which appeared in the September, 1937, issue of this magazine. Whether the tales about John Henry's exploits are truth or fantasy does not really matter, the fact remains that they have been related and sung down through the years by men at work and by idlers, some drunk and some sober.

Fewclothes, although of more recent origin, has been the object of legends as similar, as varied, and as widespread as those about John Henry. The tales, some of them very tall, began in and around the Cabin Creek and Coal River mining sections and have been told and retold until fact and fiction have been fused and confused. Every version of the Fewclothes story differs slightly from the others, but as to the main events concerning his boisterous, notorious, and romantic career the accounts all seem to be in agreement.

In contrast to John Henry, Fewclothes is portrayed as a somewhat lovable, fighting rascal. He had more flash and color than the steel driver, commanded more respect among his fellows, and exhibited more traits of daredeviltry. This observation is no slur upon John Henry's fame and reputation; the two were just different types. Fewclothes was always into something—always had a cause to espouse—always carried the torch for this or that or the other thing. Frequently it was necessary that he earn a bit of money, and the way he "earned" it was on occasions slightly, if not entirely, questionable.

Like John Henry, he is supposed to have played many roles in life. He is described as an honest man, as a good friend, as a cheat, as a liar, as a good worker, and as a lazy good-for-nothing loafer, but always as a fighter. He loved to fight. That seems to be the one definite thing about him. Also like John Henry, no one knows just when he arrived on Cabin Creek or what his reasons were for coming. He appeared on the scene suddenly, and as suddenly disappeared. Neither does anyone know from what part of the country he hailed or where he went.

The people who were on Cabin Creek and upper Coal River before 1910 will inform you that Fewclothes came from Texas, Alabama, West Virginia, and even from Mexico. Some will swear that he was a northern Negro. There are persons who hold the view that he was killed in a mine war in Pennsylvania, in Colorado, and in Illinois; others that he died a natural death. Still others will look you in the eye and tell you with all sincerity that he was killed in action during the first World War. The writer has it on good authority (if there is such a thing as good authority concerning a matter of this kind) that he met his end in a saloon brawl that started over a woman.

Fewclothes claimed that he was one of Teddy Roosevelt's Rough Riders at San Juan Hill. This may well be true, for this version of the story has it that he roared up Cabin Creek one day from the West wearing remnants of an old army uniform. His traveling companion was an armadillo, an animal that was not known to the Creek inhabitants and that caused much speculation and comment among the miners and their families.

His travelling companion was an armadillo and he carried ammunition for his Springfield rifle in a stocking slung around his neck.

Fewclothes has been quoted as saying that, but for the Negro troops, the Battle of San Juan would not have ended as it did. However, he is supposed to have been among those that were dishonorably discharged from the Army by Roosevelt following the Brownsville (Texas) riot, although he denied that he took part in it.

The event of paramount interest in Fewclothes's career for which he is best remembered seems to have been the operation of a ferry through the Seng Creek Tunnel of the Chesapeake & Ohio Railroad. It was in August of 1916 that a cloudburst and flood struck Cabin Creek, the worst disaster in its history. It washed away entire villages, buried railroad trains under tons of dirt and rock, and sent people frantically digging into the avalanche for their dead and missing. Fewclothes, always on the alert for an opportunity to earn a few nickels, took advantage of the catastrophe, "borrowed" a boat belonging to the Anchor Coal Company, and began to operate a ferry through the tunnel. A landslide at each end, caused by the downpour, had converted the passageway into an underground canal almost a mile long. There is no telling just how profitable this venture of his was (before he was arrested) because he had no fixed fare for taking people through. He told his customers, "I only charges what folks wants to give me. No regular price. Some gives me a quarter. Some a dollar. Most of 'em gives me a dollar."

This was not the last of Fewclothes and his exploits. He figures in many other equally interesting tales that appeal to the imagination. His smile,

ready tongue, and capacity for making friends were all deceiving, however, because he was bad and tough and dangerous and capable of doing almost anything. It's pretty certain that he had the reputation of being a "bad actor," for when a special officer was sent to take him into custody he was instructed by E. L. Bock, general superintendent of the Anchor Coal Company, to "Go to Seng Creek Tunnel and arrest Negro Dan Chains. He has commandeered one of the company's boats and is operating a pay ferry through the tunnel. Take another officer with you. Dan is a killer."

Fewclothes probably got his nickname from the condition of the army uniform he wore when he arrived on the Creek. When it was in rags he went around in a thin pair of overalls, patched shoes, and a battered hat, turned up all around. He is said to have lived in what was known as "White Row," which was situated at the lower end of Kayford and in Laymont Hollow. He loaded coal in the mines for a while, but most of the time just "walked the holler." He is described as weighing more than 200 pounds, and as being as strong as an ox. His favorite gun was a Springfield rifle, and he was wont to carry his ammunition in a woman's stocking that he slung around his neck. He was very fond of "tea," the kind that came in Mason jars, and he drank his share of it. If he got hard up he was not above peddling a little every now and then.

Fewclothes, so reports have it, took a prominent part in the strike wars of 1912 and 1913 in the southern West Virginia coal fields. One story goes that he shot up a train carrying guards to the collieries; but a more picturesque account tells of the day Mother Jones, a union organizer of note, opened one of her famous campaigns on Cabin Creek. An army of more than 200 miners, white and black, led by Fewclothes marched to what was then the office and store of the Cabin Creek Consolidated Coal Company. The man of the tattered garments had his Springfield in the crook of his right arm, and with his left hand held aloft a small United States flag.

It was a special occasion, and he wore pants instead of the traditional overalls. His battered hat was cocked at the usual "fighting angle." Arriving at their destination, he stopped the marching men and told them to stay where they were. Solemnly he mounted the steps that led to the porch of the building. Then he stood the flag upright against a barrel, across the top of which he placed his rifle. Slowly he turned and dared any man to touch either while he was inside to plead another of his "causes." Fewclothes, the fighter, was looking after the business that seems to have been nearest to his heart.

However, when Fewclothes was bad he was plenty bad. One day, so the tale is told, he was in Charleston out to "whup a man." As he neared the Red Bird Saloon he spied another Negro about his own size and build shouldering a keg of beer from a wagon outside of the barroom. That was the man he had been looking for, and he followed him inside. He was in there only about five minutes, and in that short period he had "whupped" not just the man he had originally intended to "whup" but five more, for that's how many became involved in the scrap once Fewclothes got it going by striking the initial blow.

And so the legends about Fewclothes, some of them similar to those about John Henry, go the rounds year after year in the small mining communities in the West Virginia hills, and no one seems to weary of telling them or of listening to them or of composing ballads and singing them. As time goes on the tales will grow and will become more incredible until one day Fewclothes may possibly take his place beside John Henry, Paul Bunyan, Mike Fink, Judge Roy Bean, Joe Hill, Johnny Appleseed, Blackbeard, and the rest—veterans all and heroes too, of American folklore.

It is interesting to note in this connection that our own legendary figures differ from those of other lands and other countries. Ours are not so much concerned with romance and tragedy, with beautiful women, or with kings and queens, as are those that have come to us from across the water. Neither is there any similarity between our stories and those from the Orient that exalt wisdom. The word pictures of our heroes usually portray big-muscled men who would fight at the drop of a hat, who worked with gusto, and who were perpetually involved in jokes on a gigantic scale—brave and hardy individuals who wrestled barehanded with wild bears and whirlwinds, who created mountains and made rivers flow, and who bent steel rails with their hard and calloused hands. They loved to drink, to tell stores, to lie and steal, and to shoot up the town. But deep down under all their rascality and mischievousness there was something good and clean. They performed gigantic feats of strength and endurance, invariably with a grin and to the accompaniment of folk songs and ballads, some of them pretty bawdy but all of them exciting.

These are the men who are the embodiment of the American spirit, for in America a man can do or be what he wants to do or be if he have the strength of character to try and the willingness to take the tough breaks and hard knocks as they come. Incidentally, our boys, who but recently finished fighting for their lives and for everything they hold dear, typify that spirit as truly as did our heroes of folklore and, like them, have performed deeds seemingly impossible and incredible.

Most of our legendary figures were real people of an era not so very long ago whose exaggerated doings have gone into the gracious world of half-truth "where the stuff of all legend lives and thrives" and which is thrilling nonetheless because it starts our fancy roving and sends us off into the land of make-believe where all things are possible.

"Some folks gives me a quarter, some a dollar. Most gives me a dollar."

This and That

Oil Pipe Lines Are Problem

The Reconstruction Finance Corporation, which put up the money for building the "Big Inch" and "Little Big Inch" pipe lines to meet the wartime emergency that arose in the transportation of crude oil and its products, apparently has a couple of white elephants on its hands. The oil companies, now that they have their tankships back from the Government, are operating them again between Gulf Coast and eastern seaboard points, and it looks as though the 24-inch and 20-inch lines linking Texas and the Atlantic will no longer be used. It is unofficially reported that the RFC will shortly order them drained and filled with compressed air, water, or some other fluid in order to preserve them.

* * *

To Train Young Miners

Through the efforts of the Ontario Mining Association, young engineering-school graduates being released from the Canadian armed forces will be given a year's training in practical mining work. They will spend four months each at a small gold mine, a large gold mine, and a base metal mine. At each property they will divide their time among the various departments—including shops, engineering office, mill, and underground. They will perform the regular work each occupation involves and will be paid for it at the regular rate. The training course is open to all who apply, and the prospects are that at least 150 will enroll. It is expected that most of the trainees will be men who entered the armed services immediately following their graduation from technical schools, although some may have worked in mines for a short time before they answered the call to the colors. The purpose of the course is twofold: to aid the graduates in making the transition from military to civilian life, and to insure mines a reservoir of technically trained men on which they can draw to fill supervisory jobs in the future.

In South Africa, the Gold Producers Committee of the Transvaal Chamber of Mines has initiated a scheme that is the reverse of the Canadian plan. Mine employees other than apprentices who return to work after having been six months or more in the service will be offered special educational courses. Those electing to do so will spend one day a week over a 2-year period at the Witwatersrand Technical College, where special classes have been arranged in mining, metallurgy, mechanical and electrical engineering, assaying, secretarial work, and accounting. They will receive their regular rate of pay while absent from their jobs. Those who show the best progress at the expiration of half a year will be permitted to enroll in a full-time 6-month course, while the others will continue on the one-day-a-week basis for the remainder of the two years.

* * *

Little Things Count

The importance of little things in warfare is emphasized by a statement from the War Production Board that bolts, nuts, screws, rivets, mechanical springs, and other small parts had an aggregate value each year since 1941 of more than $2,500,000,000. These products were made by 4635 companies with 299,000 employees and constituted 10 percent of all finished steel shipments.

* * *

Gadget Overcomes Criticism

In the State of Idaho, permits for big-game hunting are limited in number, and those receiving them are selected from the list of applicants by lot. State Game Commissioner James O. Beck, wearied of charges by disgruntled hunters that his office showed favoritism in the matter, invented a mechanical selector that has been dubbed "Beck's Bazooka." It is made of fence wire, a washing-machine motor, and parts of a vacuum cleaner. A slotted pipe runs through a wire cylinder and is turned by the motor. Applications are placed in the cylinder, and some of them fall through the slot into the hollow pipe. Puffs of air from the vacuum cleaner are blown through the pipe, and the winning applications emerge at the other end. "The gadget is absolutely unbiased," Mr. Beck remarks.

* * *

Blows Them Down

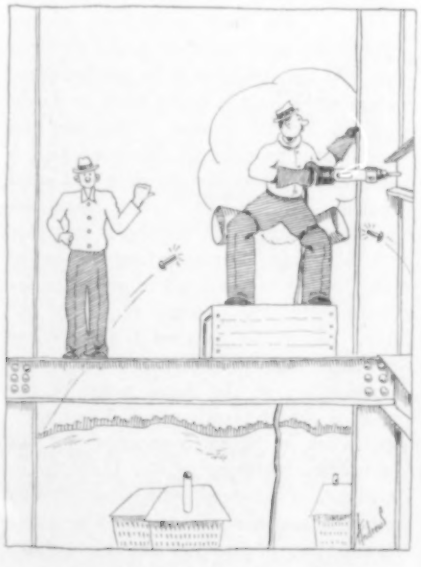
Food manufacturers say they have found a sure-fire way of keeping flies out of their workrooms. An electric fan is mounted over a doorway or other opening so as to blow a large volume of air downward with gentle velocity. This is claimed to form an atmospheric barrier that house flies, mosquitoes, and other insects cannot penetrate.

* * *

Copper Repels Roaches

Several years ago two South African doctors, who were studying the incidence of athletes' foot and other floor-borne diseases among miners using change houses, made an interesting discovery. They found that at one mine in Northern Rhodesia, where the bath water came from underground and contained minute quantities of copper, such afflictions were practically nonexistant. Before they could carry on investigations, Dean S. Hubbell, a Pittsburgh chemist, introduced his now well-known cement "Hubbellite," a copper-containing material with recognized sanitizing properties.

Hubbellite is a magnesium-oxychloride cement and was developed primarily to provide a material with improved structural qualities. It was stronger than ordinary cements and had other desirable characteristics. However, it had a tendency to disintegrate through



"Handy guy to have around."

"This is a lifetime job. It might pay to buy an air compressor."

hydrolysis and the eventual solution of the magnesium oxychloride in water. Hubbell discovered that the addition of finely divided copper enabled him to overcome this tendency through the formation of copper oxychloride, which is highly insoluble in water. Subsequently it was found that Hubbellite had excellent bactericidal and fungicidal properties, and it has been widely used as a floor covering in locker and shower rooms and other places where athletes' foot and the like are transmitted.

More recently, Hubbellite has appeared in a new role. It was applied to the floor of a Cleveland-hotel kitchen for the sole purpose of killing bacteria and mold. It was successful in this respect; but the workers also noticed that the cockroaches, that had previously defied all their efforts to exterminate them, were no longer in evidence. Laboratory tests confirmed this chance finding, although it has not been definitely determined just why the troublesome bugs find the cement uninhabitable. In any event, the discovery promises to become a boon to restaurants, dairies, and food-handling establishments. The application of Hubbellite to floors will not, however, drive all the roaches away, since they can still travel around the walls, but it will reduce the number to a minimum.

★ ★ ★

Wartime Pneumatic Devices

The Dunlop Rubber Company, Ltd., recently arranged in London an exhibit of wartime products that included several pneumatic devices. One of them was the Admiralty pneumatic wave controller that was utilized in some landing operations. It consists of a concrete keel 8 feet in diameter and 200 feet long to which are attached four flexible rubber air chambers, each having a capacity of 7000 cubic feet, containing compressed air at different pressures. A row of these controllers is anchored offshore, broadside to the incoming waves. As the latter advance, they first meet and bend over a chamber that offers least resistance, being charged with air at 1 pound pressure. They then pass on to the second, third, and fourth chambers, progressively encountering the increasing resistance of 2, 3, and 4 pounds pressure, respectively. The resultant damping action is sufficient, it is stated, to reduce a 6-foot wave to a height of 1 foot.

Also exhibited were lifting bags for jacking up heavy bombing planes that had crashed on airfield runways. Using these in tiers of three, and inflating them either from portable air compressors or gas cylinders, it was possible to raise the wings of a 4-engined plane 4 feet in eight minutes, whereas it took as much as eight hours to do the same work with hydraulic jacks. These bags were also utilized in refloating some of the hollow concrete pontoons that supported the floating highway bridges in the Mulberry harbors. When a pontoon was punctured so that water entered and caused it to sink, one of the bags was inserted and expanded, thus driving out the water and enabling the structure to serve until it could be replaced.

The principle exemplified by the lifting bags has been applied to an automobile jack introduced by a rubber manufacturer in the United States. First publicity was given to it in a news reel shown in movie houses in October. The bag is inflated with gas from the exhaust by means of a hose connection. Although the pressure thus obtainable is only 6 or 7 pounds per square inch, it is sufficient to raise a car wheel clear of the ground in a few seconds.

A LEMON TREE UNDERGROUND

A 5-foot lemon tree in full dark-green foliage grows 4000 feet below ground on the seventeenth level of the Bunker Hill & Sullivan lead-silver-zinc mine at Kellogg, Idaho. It is thirteen years old and has never been exposed to sunlight. Reports have it that it sprang from a seed planted by a miner who had a piece of lemon in his lunch bucket. The dark-green foliage is characteristic of plants which, according to elementary botany, make their own food by photosynthesis, using water, carbon dioxide, and "sunlight." The tree contrasts sharply with the many parasitic plants found underground. The latter obtain their food from previously existing organic matter such as rotting mine timbers, and are characterized by a lack of the green coloring that indicates photosynthesis. The lemon tree has obtained light only from ordinary 150-watt incandescent bulbs overhead. There was only one there for a long time, but a second has recently been added. The plant evidently receives from these sources whatever wave length of light radiation it requires. The atmosphere in which it is growing is warm and rather humid. The photograph is reproduced through the courtesy of Stanly A. Easton, president of the mining company.

★ ★ ★

New Plane Markers

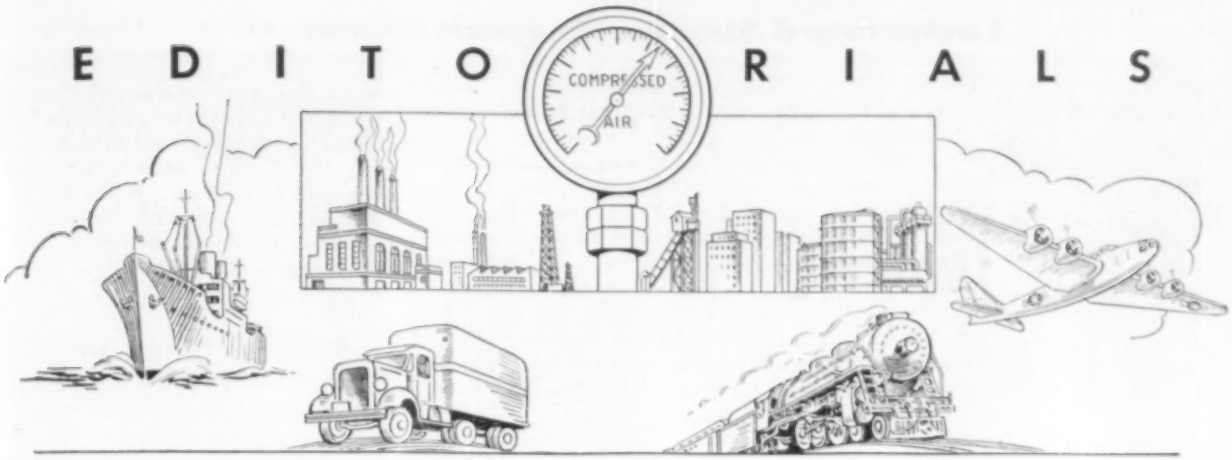
A new system of ground markings to aid airplanes has been approved by the International Civil Aviation Conference and is expected to be adopted soon by the 21 American republics and eventually throughout the world. It provides for the use of longitude and latitude in degrees and minutes instead of in degrees and tenths of degrees, as at present. The markers will be painted in chrome yellow, with a black-bordered arrow pointing true north and flanked on the left by the latitude numerals and by the longitude numerals on the right. In towns adjacent to airports, markers will include the name of the place in letters at least 10 feet high, with arrows pointing toward the nearest hard-surfaced landing field and indicating the intervening mileage.

★ ★ ★

Soviet Solar Boilers

According to a report from the *Anglo-Russian News Bulletin*, the Soviet Government has been experimenting with solar-heat boilers and has set up a working model in Moscow. On the strength of its performance a large-scale unit is being built in Tashkent, in Asiatic Russia, where the sun shines nine months in the course of a year. The helioboiler consists of a solid concrete column, 14.75 feet high, on which is mounted a parabolic reflector 32.8 feet wide. Surmounting this is the boiler, which is expected to generate approximately 264 pounds of steam per hour. The model, located in a much less favorable region, develops a very high temperature at the focal point of the reflector, which is only about 5 feet wide. The work is being conducted by the Energetics Institute of the U. S. S. R. Academy of Sciences, which has already designed another unit with 2½ times the capacity of the one under construction.

EDITORIALS



MADE TO LAST

THE war taught a lot of people that most American-built mechanical goods will last a long time if given reasonably careful treatment. Many a motorist who could no longer pursue the habit of buying a new car every year or two was pleasantly surprised to find that his prewar model continued to function satisfactorily as the years rolled by. A large segment of the populace knew this would happen, of course, for most automobile owners never possessed a new one, always having purchased a used one turned in by the more fastidious or more prosperous driver.

Throughout the war period we were continually reminded to take care of our cars. Most people tried conscientiously to follow this advice, but they had a hard time finding qualified mechanics to do the work. Maintenance problems were complicated by many troubles that arose from not enough driving. This was especially true of fouled spark plugs and cold-weather ailments such as the formation of crankcase sludge.

The automobile mortality rate was undoubtedly high during the past four years, although motorists that have tried to find parking space in any city since gasoline rationing was lifted are inclined to doubt that as many cars were scrapped as was reported. Statistics gathered by a manufacturer of one medium-priced auto show that only 7 percent of his machines have been retired from service since 1941. On the other hand, the survey discloses that 143,557 of the cars of that make on the highways are from 11 to 40 years old. This represents more than 9 percent of the total number. Investigation would no doubt reveal similar good durability records for radios, refrigerators, washing machines, and other household appliances, all of which indicates that the consumer gets his money's worth from these classes of merchandise.

Fortunately for manufacturers, distributors, and workers, the public will not acquire the habit of doing without new machines and appliances as a result of its favorable wartime experience. Style and appearance always are strong buying incentives, and mechanical advances embodied in new models also exert a strong appeal. Americans will be content with what they have only so long as their neighbors have nothing better. Our purse strings are loosened by that well-rooted urge of "keeping up with the Joneses."

MEN AND MACHINES

THE National Machine Tool Builders' Association has issued a booklet outlining the relationship between jobs, machines, and prices of mechanical goods in America. It contains statements that have been made many times previously, and yet they may be so vital to our future welfare as to merit the emphasis resulting from repetition.

The booklet summarizes our industrial history in these words: "Manufacturers have used machines to cut costs and thereby get prices down to where people could buy their products. Until they got prices down, they couldn't do a large volume of business. Until they did a large volume of business, they couldn't employ many men. Cost-cutting machinery has therefore been the very foundation of high-level employment."

Case histories of several important industries are cited in support of this declaration. It is pointed out, for example, that the 1910 automobile, crude as it was, sold for more than $1000. Machine tools, also crude at first but continually improved, enabled car builders to reduce costs steadily until, in 1940, they were able to give buyers a far better product for $1000 than they got in 1910. Employment in the automobile industry had meanwhile leaped from 140,000 to 450,000.

The story of washing machines follows similar lines. The inefficient and ugly machine of 1920 cost $170. Far better ones sold for around $80 in 1940, and the volume of sales increased accordingly. Likewise, employment in the industry rose from 5000 to 9600.

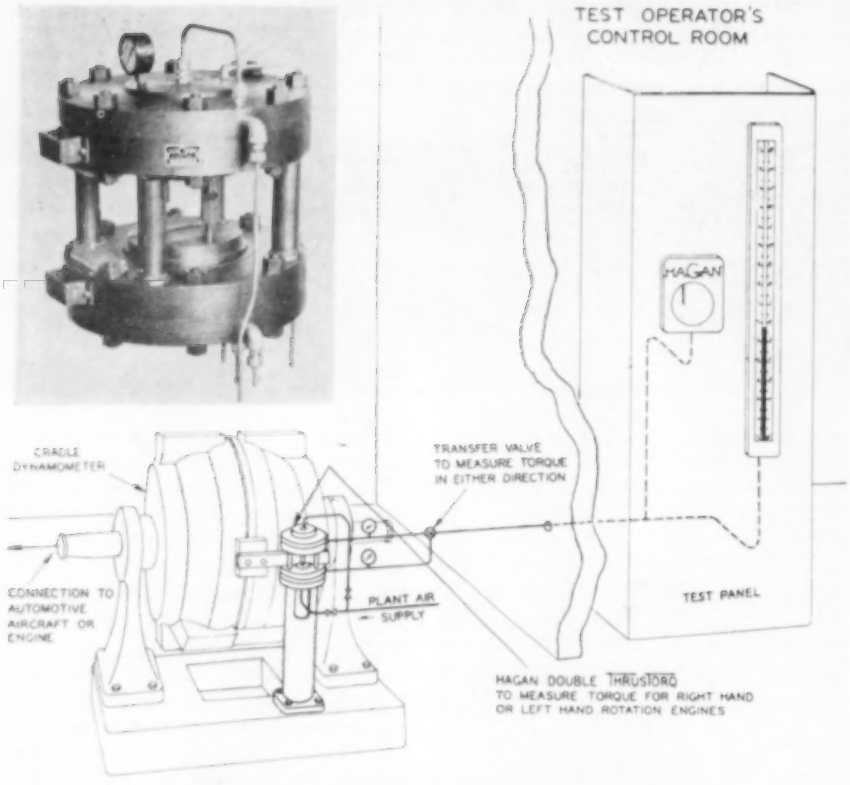
The 10,000 mechanical refrigerators that had been made up to 1920 averaged $600 in price. Improved tools and equipment cut the cost to $275 in 1930, and by 1940 some models sold for under $100. That year 35,000 persons were employed in the industry.

Parallel stories can be told with respect to radios, vacuum cleaners, electric ironers, farm tractors, and numerous other items. In every case employment outside the factories has grown apace with that inside of them. For instance, more automobiles mean more salesmen, more garages, more service stations, more gasoline produced and refined, and many more jobs.

To see how machinery affects our place in international economy, let's look at the coal industry. The United States produces three times as much coal as Great Britain with only 55 percent as many miners. In other words, our output is five and a half times greater per employee (recent figures show 1491 tons a year per man as against 268 tons in Britain). Does that mean that our miners are supermen, or that they work longer each day, or that our coal deposits are thicker or otherwise more favorable to easy mining? Authorities say it does not. The average weekly wage of miners in America is twice the British figure. Despite this difference, the average price of a ton of coal doubled in Britain during the war and advanced only 60 cents here.

The explanation is found in the greater use of mechanical equipment in America. Ninety percent of our coal is cut with power-driven devices and 50 percent of it is loaded with machines. Hence the labor cost of raising a ton of coal to the surface is much less here than in Britain. In Great Britain, where coal production is vital to the national economy, ways are being sought to get more men into the mines. In America, coal-mine operators have announced that they will spend probably $200,000,000 in the next five years to increase mechanization.

Compressed Air as a Measuring Medium


TEST OPERATOR'S CONTROL ROOM
HAGAN
CRADLE DYNAMOMETER
TRANSFER VALVE TO MEASURE TORQUE IN EITHER DIRECTION
CONNECTION TO AUTOMOTIVE AIRCRAFT OR ENGINE
PLANT AIR SUPPLY
TEST PANEL
HAGAN DOUBLE THRUSTORQ TO MEASURE TORQUE FOR RIGHT HAND OR LEFT HAND ROTATION ENGINES

INSTRUMENT AND LAYOUT OF SYSTEM

Typical installation of the Thrustorq (insert) on a cradle dynamometer for measuring the torque or horsepower of an automobile or airplane engine.

MEASURING and weighing with air is the purpose of a new instrument that is said to be so sensitive that it can gauge with equal facility the force of a small missile propelled by a boy's peashooter or the thrust of a giant jet-airplane engine. The device was developed by the Hagan Corporation and is known as the Thrustorq. Its heart is a flexible diaphragm which forms one face of an airtight chamber to which compressed air is admitted through a poppet-type pilot valve. The force to be determined is applied to the outside of the diaphragm and is opposed by internal pressure. As the force increases, the pilot valve opens and admits more air to balance it. Conversely, as the force decreases, air is exhausted until the external and the internal pressures are equal. Thus the air pressure within the chamber provides a direct measure of the external force. The response of the instrument is practically instantaneous, it is claimed, because the diaphragm movement necessary to operate the pilot valve is extremely small.

Inasmuch as the force is measured by air pressure, the Thrustorq permits remote readings on any number of manometers, pressure gauges, or similar devices so that every person connected with a test may have his own recorder in front of him even if he be in a different room or building from that in which the test is being conducted. Its first application in industry was the obvious one—that of determining the thrust and torque of engines, but it has many other uses. Because of its compactness and the fact that hardly any deflection is required to provide a reading, the system can be utilized to analyze many structural stress and strain problems. Further, as it will function in any position, it is serving one manufacturer to measure the horsepower of vertical helicopter engines.

Dowel-Setting Machine

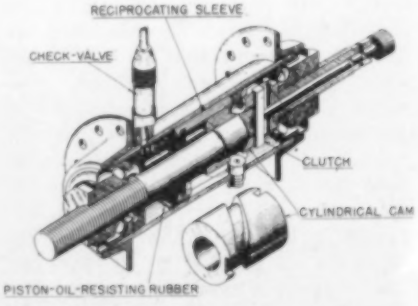
A NEW piece of roadbuilding equipment that rides the rails of the steel forms is the Allen Doweler which was developed by J. A. Golden, superintendent for the M. H. Golden Construction Company, San Diego, Calif. The machine sets the dowels in position at the contraction joints without the use of the customary supporting chairs and tie bars. It carries a supply of dowels in a shuttle jig from which they are transferred mechanically by an injector that inserts them, it is claimed, in the right position in the fresh concrete.

At present there are two Dowelers in service. These units are maintained by the owner and manufacturer and are working on a price-per-dowel basis. On a paving job, poured in 25-foot strips and requiring 100,000 dowels spaced on 12-inch centers, or 25 per contraction joint, the new equipment is said to have shown a saving of $11,720. By the old method, just the outlay for supporting chairs and tie bars, at the rate of 4 and 34 cents, respectively, would have amounted to $10,720.

Automatic Bicycle-Tire Pump

AN automatic tire pump incorporated in the hub of a bicycle wheel is a new British device that will enable a cyclist to inflate his tires as he rides. The inventor is F. L. Stabback, a Liverpool engineer, and his pump consists essentially of a sleeve, a piston, and a cam. The hub shell serves as the pump cylinder, within which a tubular piston is made to reciprocate by the action of the cam. The compressed air flows up a hollow wheel spoke and enters the tire through a conventional valve. The device is brought into play by turning a lever located on one of the handle bars and, by means of a thumb screw, may be set for any desired pressure up to 100 pounds per square inch. So adjusted, no more air enters the tire after it has been inflated.

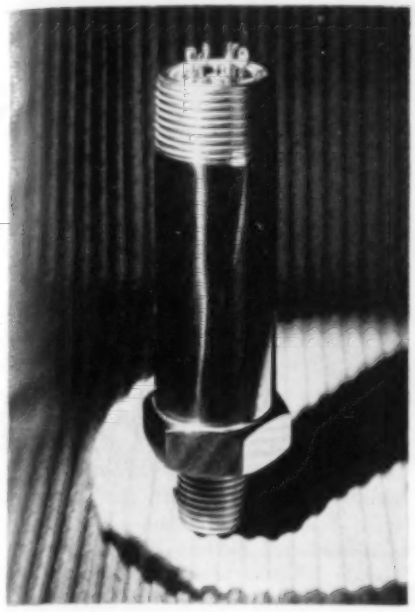
To compensate for slight overnight leakage through the valve, the cyclist sets the pump going when he starts out in the morning, and a few yards of travel will bring the pressure up to normal. In the case of a slow-leaking puncture, continuous operation will maintain riding pressure until it is convenient to make tire repairs. If a tire is found to be flat, the wheel can be lifted off the ground and spun by hand until the tire is inflated.



HOW PUMP OPERATES

Cutaway sketch shows working parts. The hollow piston rotates with the hub and wheel but is free to slide from side to side. The cam that actuates the piston is inside the latter and has a helical groove cut in it. A stud riveted to the piston runs in this groove and, as the hub turns, causes the piston to reciprocate. When the pump is not in operation the cam turns with the piston.

Pressure-Sensitive Measuring and Control Device



SENSITIVE TO PRESSURE

This device for measuring, recording, or controlling gas or liquid pressure is approximately 1 inch in diameter and 5½ inches long. It has been found to be accurate to within ¼ of 1 percent of full scale.

WITH the fact in mind that the electrical characteristics of a wire filament change with physical strain, the Southwark Division of the Baldwin Locomotive Works has developed a pressure-sensitive device that promises to open new fields of measurement and control. The instrument is known as the SR-4 Pressure-Sensitive Device and is designed to convert gas or liquid pressure into electrical energy for the purpose of measuring, recording, or controlling. It is based on the principle of the SR-4 Strain Gauge, which is said to be the most efficient instrument yet devised to give engineers accurate information on the strains and stresses of materials and structures under actual load conditions.

The heart of the new device is a very fine wire filament which is bonded to a hollow metal core against which is exerted the pressure to be determined. As the pressure increases, the filament stretches, thus changing the diameter of the wire and causing measurable changes in its electrical resistance. These vary the amount of current flowing through the filament circuit and, when amplified, show up on a dial or are used to actuate a control system. The wire is sensitive to a "stretch" of the metal core of as little as one-millionth of an inch.

The instrument is hermetically sealed, and an ingenious built-in compensator offsets the effect of any extraneous force such as temperature. The former is about 1 inch in diameter and 5½ inches long, and is available in several ranges, the maximum being 0 to 20,000 pounds per square inch. Because it is essentially an electronic device it permits the results to be transmitted long distances, even by radio, thus eliminating the trouble with leakage and clogging experienced with the conventional capillary tubes of other pressure-sensitive instruments. Among the many industries that would find the SR-4 Pressure-Sensitive Device a valuable adjunct are steel mills, refineries, hydroelectric stations, chemical plants, processing plants of all kinds, as well as oil fields and oil and gas pipe lines.

Low-Cost Gas from Lignite

UNLIMITED supplies of gas from North Dakota's vast lignite resources is the object of experimental work by the U. S. Bureau of Mines. V. F. Parry, supervising engineer of the bureau's subbituminous and lignite coal section, has invented a retort for the carbonization and gasification of noncoking coals. The pioneer unit has an hourly capacity of 100 pounds of lignite and performed so satisfactorily that a commercial-size plant, based on the same principles and designed for an output of 400,000 cubic feet of gas a day, has been built on the campus of the University of North Dakota at a cost of $125,000. This is in line with the so-called North Dakota-Minnesota plan, which has for its primary purpose the generation of gas from North Dakota's lignite for the reduction of Minnesota's low-grade iron ore.

The problem of making gas from lignite was attacked independently by Mr. Parry at the Bureau of Mines station at Golden, Colo., and by Dr. Lloyd L. Reyerson, professor of chemistry at the University of Minnesota. The results of their efforts have been combined in the present program, as outlined, but eventually it is the purpose also to produce gas for cooking, heating, and general industrial uses, as well as for conversion into liquid fuels.

The Parry retort consists essentially of two hollow columns, one inside the other. The material to be gasified enters the annular space at the top and, as it moves downward through the upper section, gives off as much as 35 percent of its moisture content. In this process of self-steaming some gas is generated. Continuing downward, the now charred lignite encounters superheated steam and produces more gas. The product of both zones passes up and out through the chamber in the central column and is subjected to the customary scrubbing and cleaning operations before it it put to use.

HELIUM FOR TIRE INFLATION

The use of helium in airplane tires is being tried out at Akron, Ohio, by the Goodyear Tire & Rubber Company. It is stated that it takes only 13 pounds of helium to inflate a 110-inch tire, as against 92 pounds of air. There is, consequently, an indicated saving of 79 pounds, but the actual saving, which is not reported, is considerably less because dual seal tubes are required to confine the helium, which diffuses through rubber faster than does air. In the case of natural rubber the diffusion rate for helium is 2½ times that of air; with butyl rubber the diffusion rate is decreased, it is stated, to a point where it is only 67 percent greater for helium than for air. Before the helium is introduced, air is evacuated from the tire. The picture shows Parry Keller (left) and W. E. Shively, Goodyear tire-design technicians.

Industrial Notes

Splintery, worn wood floors can be salvaged, it is claimed, by a ½-inch topping of a lightweight plastic made by Flexrock Company. The material combines the durability of concrete with the flexibility of wood and is available in seven colors.

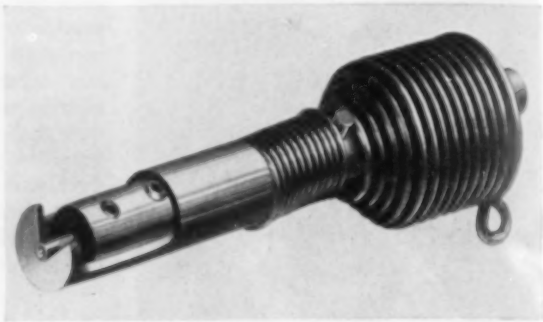
Ductile Chrome Process Company, Donald Place, Detroit, Mich., has developed and patented a chromium-plating solution that necessitates no change in standard plating equipment. Firm is prepared to do work in its own shop or to license others to use its system.

Samples large enough for testing can be obtained of the new specially processed cotton diaphragm cloth made by Irving Varnish & Insulator Company, Irvington, N. J., for fuel-pump and similar uses. The fabric has good pressure and tear resistance, it is claimed, remains flexible, and insures quick recovery over a wide range of operating temperatures.

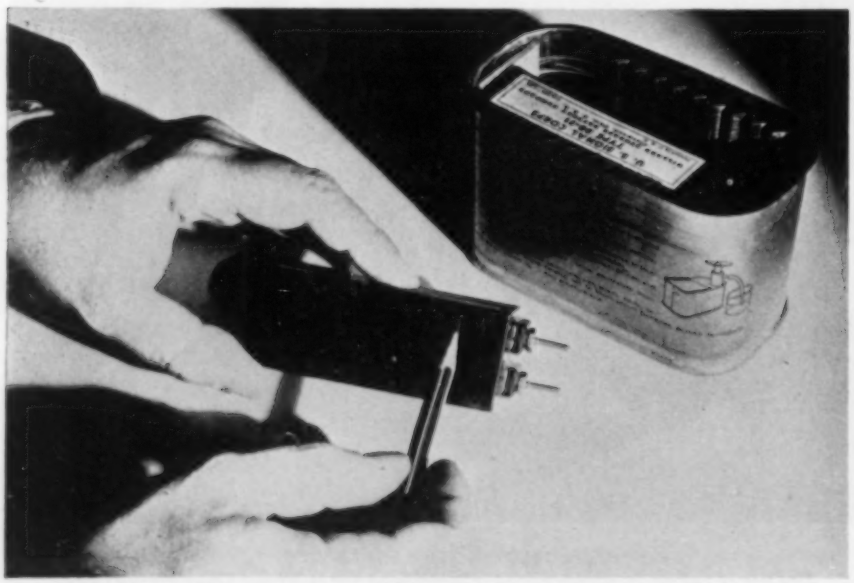
Ferrolith "G" is a new product of L. Sonneborn Sons, Inc., and is described as a valuable aid in concrete patching, grouting, repointing mortar joints, sealing precast pipe joints, etc. Mixed with cement and applied as a grout, the compound is said to expand upon oxidation and thus to offset concrete shrinkage. According to the maker, its use eliminates vibration and shifting of machinery, strengthens structural and other supporting columns, and provides a secure anchorage for bolts. Machinery can be operated and bolts used from 12 to 24 hours after application, it is claimed.

An air-actuated collet chuck that automatically compensates for variations in stock size up to 1/32 inch is being produced by the Symmetric Manufacturing Company. The device is controlled by a foot valve and is said to permit the interchange of collets without adjustment of the chuck head or its removal from the machine. It includes a regulator to control the clamping pressure and an adapter plate that insures full concentricity with any machine center.

Removing and not driving rivets is the purpose of the tool shown in the accompanying illustration. It was designed primarily with the aircraft industry in mind, but its use is not confined to that field. It is an adjunct to any standard pneumatic rivet gun and comes in five models for the removal of defective rivets ranging from 3/32 to ¼ inch in size. It is usually the practice to drill out such rivets, but that enlarges the hole and necessitates driving a bigger



replacement rivet. With the new tool, we are told, there is no change in the size of the hole nor in that of the new rivet. The device is attached to the gun by a retainer spring, and a cone point on a punch is centered on the head of the rivet to be withdrawn. With a 2-way bucking bar at the back to prevent deformation of the skin surface, a few strokes of the hammer drive the punch through the head, while a few follow-up blows push the sheared rivet shank out and into a recess in the bucking bar. A spring-backed sleeve carrying a stripper head removes the rivet-head ring from the punch. Air at a pressure from 75 to 90 pounds is required to operate the tool, which is a product of the Topflight Tool Company.



VACUUM-PACKED BATTERY

The vacuum-pack principle of canning foods for safekeeping has been applied by the American Can Company to a container for storage batteries sent aloft in weather-observation balloons by the Army Signal Corps. When the oblong, key-opening container is punctured, sulphuric acid is sucked from a convenient reservoir through the piercing tool into the battery. About 25 inches of vacuum is used. Fluted liners hold the battery clear of the sides of the can. Prior to the development of this container it was necessary to inject acid into the battery through eighteen small apertures, one of which is indicated by the pencil point.

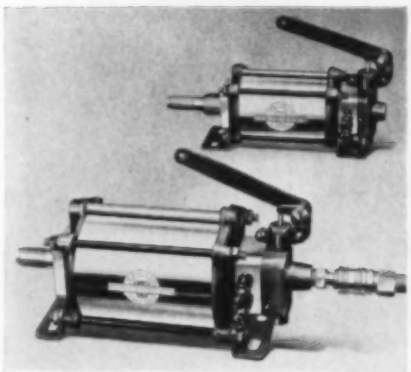
In the form of tape and tubing, the Peninsular Chemical Products Company is making insulating and masking materials for plating operations. Known as Pen-Tape and Pen-Tube, the first serves to insulate plating racks and to mask parts for selective plating. It is said to conform readily to irregular contours and, because of its elasticity and frictional properties, to remain in place. Is easy to remove after work is done and can be reused many times. Standard product is ¾ inch wide, but can be obtained in special widths. Pen-Tube is of the same material and is designed to insulate plating-rack contact wires. It comes in standard inside diameters from 1/16 to 1 inch.

Chemists of the Ohio State University have recently completed research work which indicates that concrete will last much longer with less maintenance if a by-product of the paper industry is added to the cement. Tests have shown that best results are obtained with that material when each of the countless particles is wet all over, but the investigators have found that when cement is placed in water many of the particles bunch or flock together, a tendency that greatly reduces their combined effective-

ness. When a small amount of calcium lignosulfonate is added, the particles are dispersed by electrostatic action. Experiments by Federal departments have proved that concrete made with cement of this kind is stronger, less porous, and lasts from four to five times longer than it would normally. It has already been used in the construction of buildings, bridges, dams, airports, reservoirs, filtration plants, and highways.

Chlorinated paraffin performs such useful functions as weather- and flameproofing textiles of all kinds, carpets, linoleum, paints and other coating compounds, etc. It has had extensive wartime application and is now available for industrial use. Hercules Powder Company has developed a type known as Clorafin.

Termed the "big brother" of the BM5 air motor, the BM10 recently announced by The Bellows Company is said to develop a piston-thrust force of approximately 500 pounds on an air-line pressure of 100 pounds, or more than twice as much as its prototype. The units function on any pressure up to 175



pounds and can be readily adapted to meet the needs of a wide range of machine-production processing. They differ in design from conventional double-acting air cylinders in that the valve and all operating controls are an integral part of them, insuring full and positive action all the time. Independent valves regulate the speed with which the piston rod is advanced and retracted. The operating lever is adjustable to permit connection and synchronization with any reciprocating machine movement. Motors are small and suitable for top, bottom, and side mounting. Standard BM10's have a piston stroke ranging from 1½ to 18 inches. Special units with strokes from 1 to 48 inches are made to specifications.

Designed for use where continuous or periodic vacuum readings are required, the Model 18 Tru Vac vacuum indicator recently announced by the Continental Electric Company operates directly from a 110-125 volt alternating-current line. It is calibrated to give readings of pressures from 0.25 to 250 microns and is said to be accurate within plus or minus

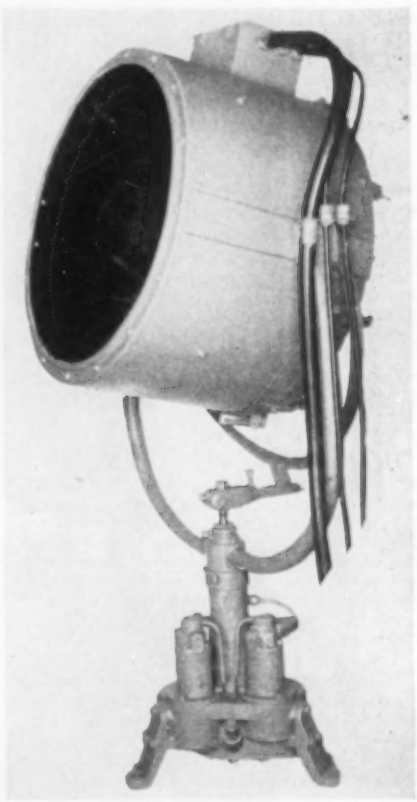
5 percent with constant-voltage input. Meter and controls can be attached to vacuum system or mounted at a distance from point where measurement is to be taken. Gauge includes provision for easy compensation of line-voltage fluctuations, a zero adjustment potentiometer, protection against shorts, etc., and is unaffected by changes in barometric pressure. Each is guaranteed for a year against mechanical and electrical defects.

To protect work and fixtures against welding spatter, The Lincoln Electric Company has introduced a liquid that is said to possess the following characteristics: Welding can be started directly after application, whether surface be wet or dry; priming coats of paint may be laid on the film, or the latter may first be removed by washing with water; one application is adequate for multiple-pass welding; and spatter can be removed easily. The product is called Non-Spatter and is spread by brush or spray gun.

Among the standard equipment carried by Army airplane pilots is a combination compass and match case that may prove of equal value to men like prospectors whose work takes them into remote and unknown areas. The dial-type, liquid-filled compass is sealed inside the cap of the molded-plastic case and screws on to the match box, which holds two layers of half-size waterproof matches. The whole thing weighs less than 2 ounces, is 1 inch in diameter and 3 inches high, and is made in accordance with rigid military specifications.

For melting solid oil, grease, and similar compounds in standard 55-gallon drums and like containers, Edwin L. Wiegand Company has designed an immersion heater that works its way down through the contents. Steel-sheathed electric elements forming nearly a complete ring constitute the heater base, from which electrical connections lead up through a steel tube to a terminal box. Control is effected either by a thermostat or a 3-heat switch mounted on the box. Unit is available for operation on 115- or 230-volt single-phase current in ratings up to 4000 watts.

Vibration and improper installation of fluorescent lamps sometimes cause them to fall and to endanger workers and machinery. To prevent such accidents there has been designed an inexpensive locking device that is being distributed by the Laduby Company of New Haven, Conn. It is available in three types suitable for all standard sockets and for 20- to 100-watt lamps. A circular with a sample lock and instructions for use may be obtained free of charge.



CONTROLLED BY AIR

The movements of this General Electric "Novalux" searchlight are remotely controlled by means of compressed air. The light is designed primarily for service aboard ship, and the vessel's regular air-supply system is used to operate it. Two piston-type reversing air motors are mounted on a gear box at the base, and leading to each motor are two pipes to which air at 100 pounds pressure is fed through a 4-way universal valve, usually located in the pilothouse. By shifting a control handle the light can be elevated or depressed while rotating it in either direction. Speed of movement varies with the quantity of air admitted, which is subject to control by the handle operator. Only a small amount of air is required to start the movement, and the maximum air consumption at full speed is 8.1 cfm.

Industrial Literature

A 16-page catalogue, No. 451, on its mine skips and cages and other products for the mining industry is offered free by Lake Shore Engineering Company, Iron Mountain, Mich.

Circular No. 60, issued by Chicago Tool & Engineering Company, 8383 South Chicago Ave., Chicago 17, Ill., describes a new Palmgren underwater arc-oxygen cutting torch and kit.

Practical information on cup, flange, U, and vee packings for the design engineer is contained in *Packing Pointers*, published by Graton & Knight Company, 356 Franklin Street, Worcester 4, Mass. It is divided into twelve sections and includes an illustrated discussion on the correct design of machine parts adjacent to mechanical packings.

The applications of beryllium are set forth in a new leaflet which may be had free from The Brush Beryllium Company, 3714 Chester Ave., Cleveland 14, Ohio. Beryllium is the only light metal with a high melting point and is now available to all users either in pure metal, oxide, or alloyed with copper, nickel, or aluminum.

The General Box, published by General Box Company, Chicago, Ill., gives details regarding various types of containers made for packing a wide range of products.

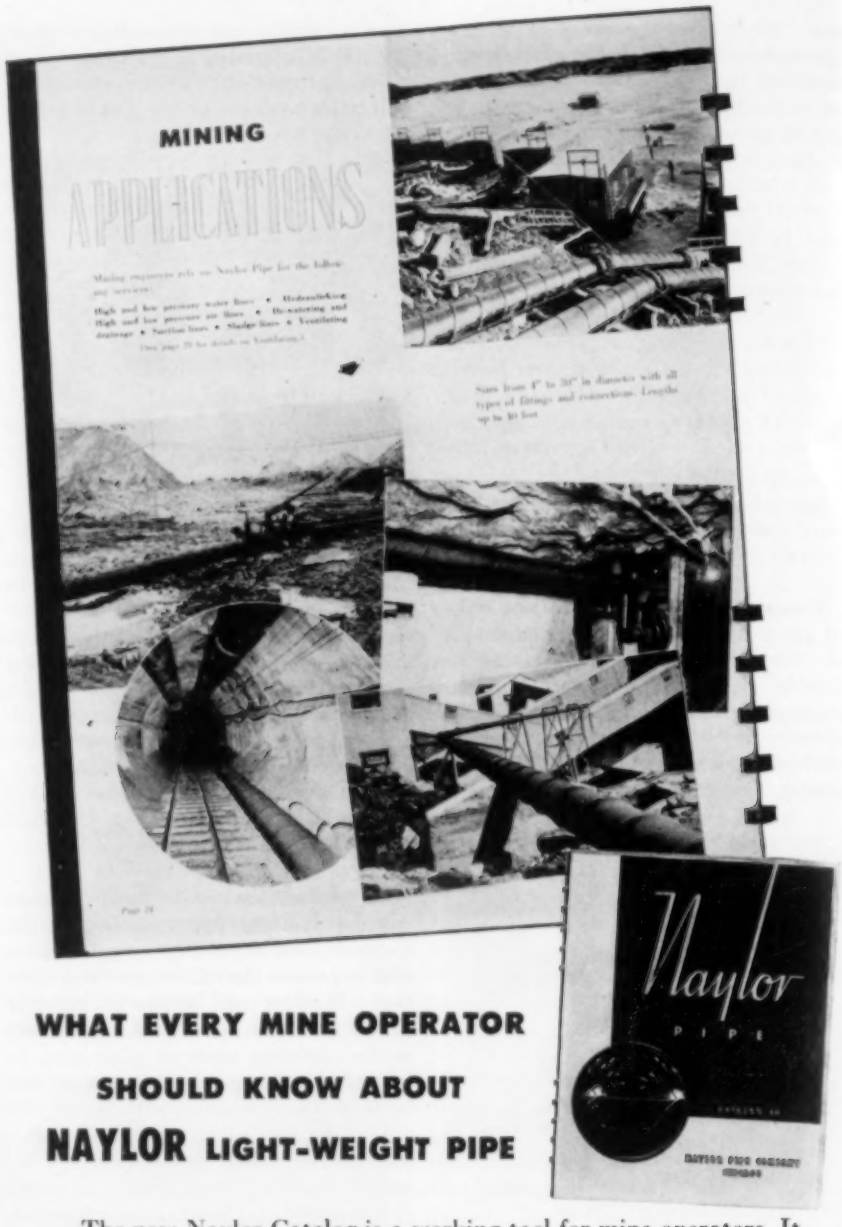
Methods of controlling vibration of industrial machinery and the advantages gained thereby are discussed and graphically illustrated in Catalogue SP 650, *Vibration in Industry*, issued for free distribution by The Korfund Company, Inc., 48-15 Thirty-second Place, Long Island City 1, N. Y.

The effectiveness with which people can see largely governs the work for which they are fitted. Although most physical and mental capacities of employees are difficult to change, visual performance can be improved with optical aids. A study of this subject is set forth in *Vision in Industry*, which is published by Bausch & Lomb Optical Company, Rochester, N. Y., and is available upon request.

The Wm. Powell Company, 2503 Spring Grove Avenue, Cincinnati 22, Ohio, has reprinted in booklet form a series of trade-paper advertisements covering the "what," "why," and "where" of valves. It is called *The Powell Quiz Kit*.

Hose couplings for virtually every purpose are described in an illustrated catalogue, No. 644, issued by Hose Accessories Company, Lehigh Avenue and 17th Street, Philadelphia 32, Pa. One section is devoted to pointers on the proper selection, attachment, and application of couplings. The same concern has issued a service manual, *How to Select and Attach Hose Couplings for Best Results*.

Silicone compounds are synthetic substances built upon frameworks of silicon and oxygen atoms similar to those existing in sand, glass, and many mineral silicates. They are available in various forms, including fluids, resins, varnishes, greases, and silicone rubber. All are characterized by temperature stability, inertness, waterproofness, and excellent dielectric properties. Dow Corning Corporation of Midland, Mich., first producer of silicones, has issued a new descriptive pamphlet about them that is free for the asking.



WHAT EVERY MINE OPERATOR SHOULD KNOW ABOUT NAYLOR LIGHT-WEIGHT PIPE

The new Naylor Catalog is a working tool for mine operators. It gives you valuable data on the use of this distinctive light-weight pipe in the mining field. For example, it lists applications on which Naylor Pipe can do a better job more economically. It explains how Naylor Pipe is built to give advantages found in no other light-weight pipe. And the revolutionary new Naylor coupling, fully described for the first time, will save you time, work and money.

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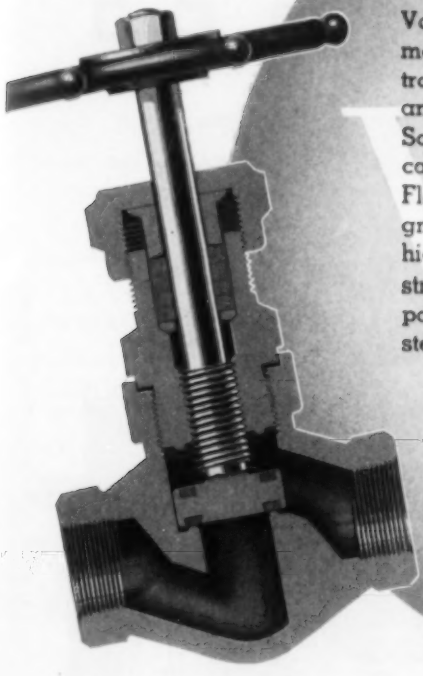
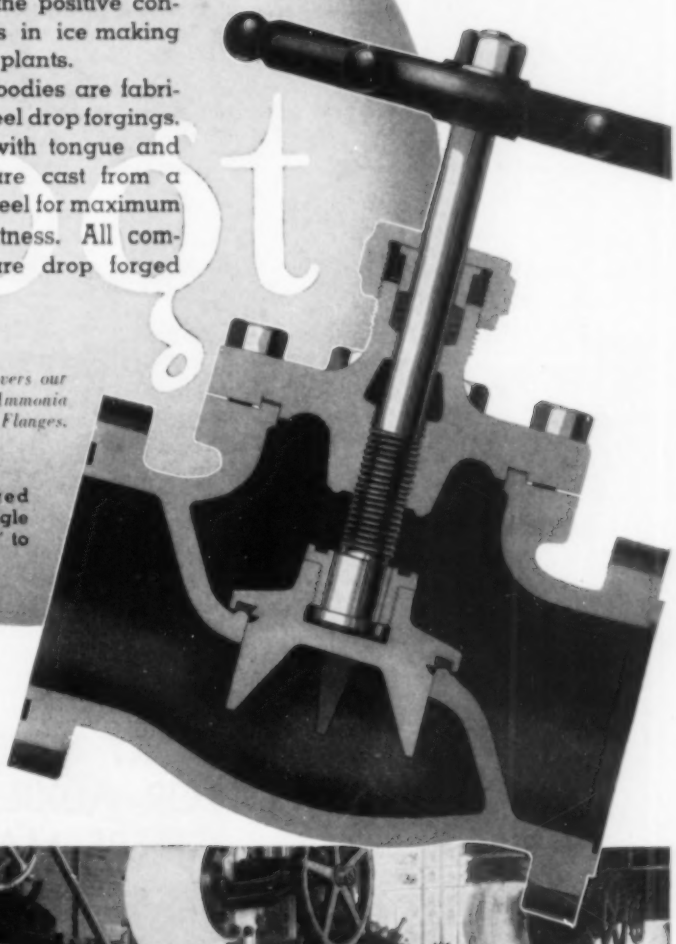
DROP FORGED STEEL AND SEMI-STEEL VALVES FOR ICE MAKING AND REFRIGERATING PLANTS!



Vogt builds a complete line of ammonia valves for the positive control of refrigerants in ice making and refrigerating plants.
Screw end valve bodies are fabricated from solid steel drop forgings. Flanged bodies, with tongue and groove facings, are cast from a high grade semi-steel for maximum strength and tightness. All companion flanges are drop forged steel.

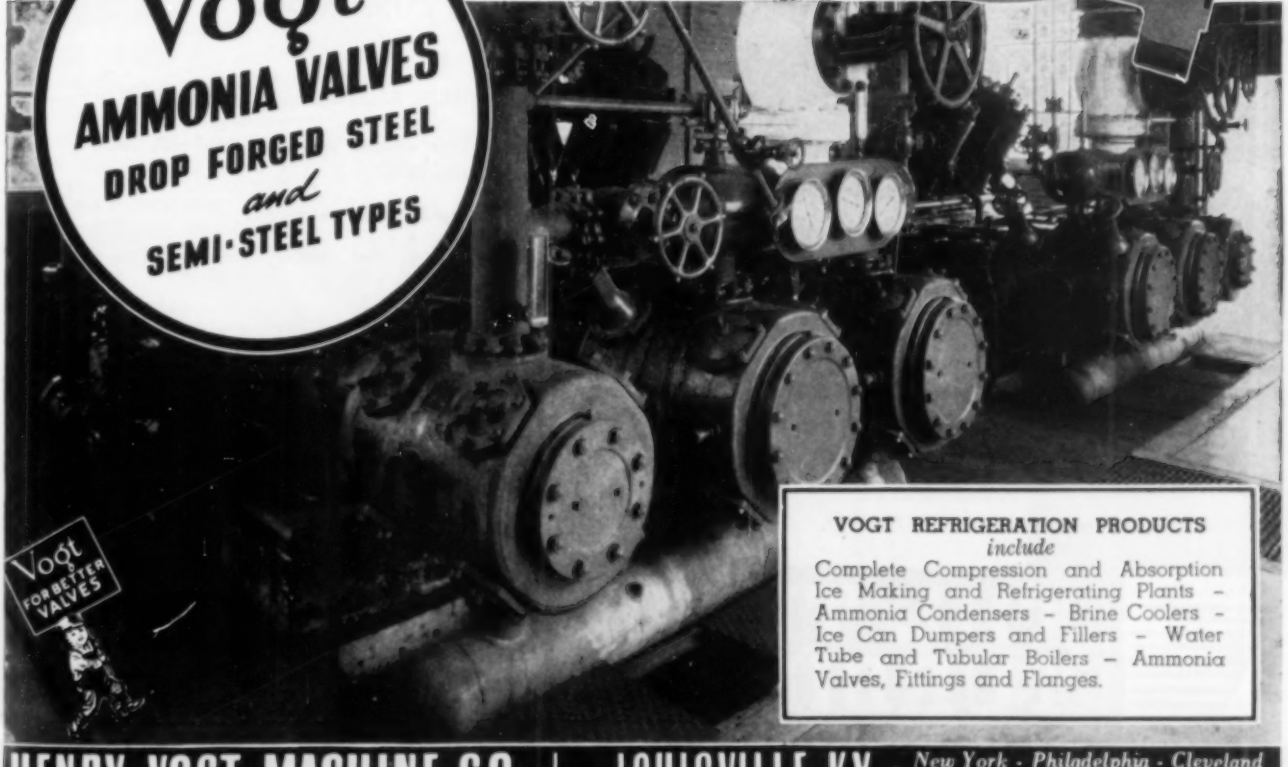
Catalogue AF-2 covers our complete line of Ammonia Valves, Fittings and Flanges.

(*Right*) **Flanged Globe and Angle Valves from 1/4" to 10" inclusive.**



(*Above*) **Screw End Globe and Angle Valves from 1/4" to 2" inclusive.**

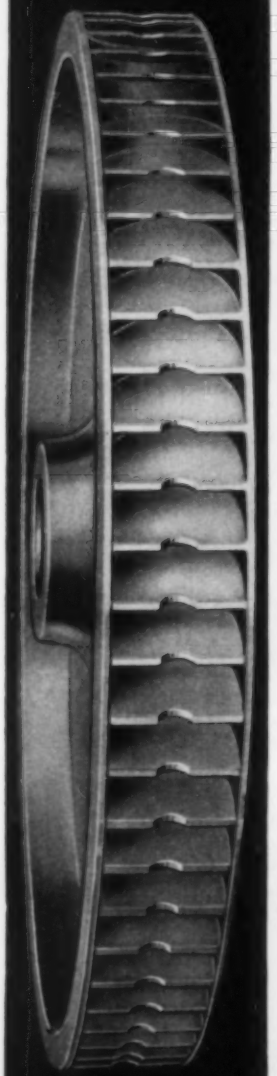
Vogt
AMMONIA VALVES
DROP FORGED STEEL
and
SEMI-STEEL TYPES



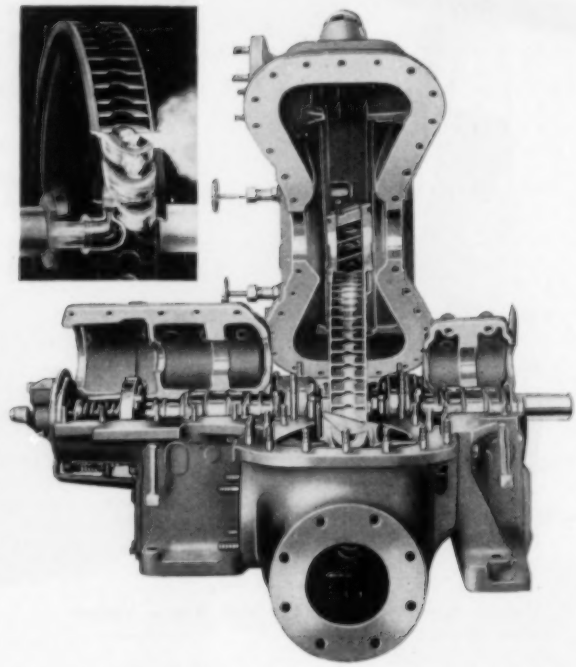
VOGT REFRIGERATION PRODUCTS
include
Complete Compression and Absorption Ice Making and Refrigerating Plants – Ammonia Condensers – Brine Coolers – Ice Can Dumpers and Fillers – Water Tube and Tubular Boilers – Ammonia Valves, Fittings and Flanges.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY. *New York - Philadelphia - Cleveland Cincinnati - St. Louis - Chicago - Dallas*

TERRY



Action of steam in Terry solid wheel and reversing chamber.



Typical Terry Solid Wheel Turbine with casing cover and bearing caps raised. Note ruggedness and the accessibility of all parts. Units of this type are used to drive all types of power plant auxiliary equipment built in sizes from 5 H.P. to 2000 H.P.

THE TERRY WHEEL TURBINE- FOR AUXILIARY DRIVE— OFFERS MANY ADVANTAGES

FROM THE SMALLEST TO THE LARGEST, THESE RELIABLE TURBINES HAVE—

- ★ Indestructible one piece wheel.
- ★ Large radial and exial clearances.
- ★ Double rim protected blading.
- ★ Individual nozzle control.
- ★ Dependable and durable governor.
- ★ Heavy dust-proof bearing and governor housing.
- ★ Independent overspeed trip with separate valve.
- ★ Sturdy casing design.
- ★ Strong and easily inspected steam strainer.
- ★ Truly accessible construction, which makes inspection of the interior parts a simple matter.

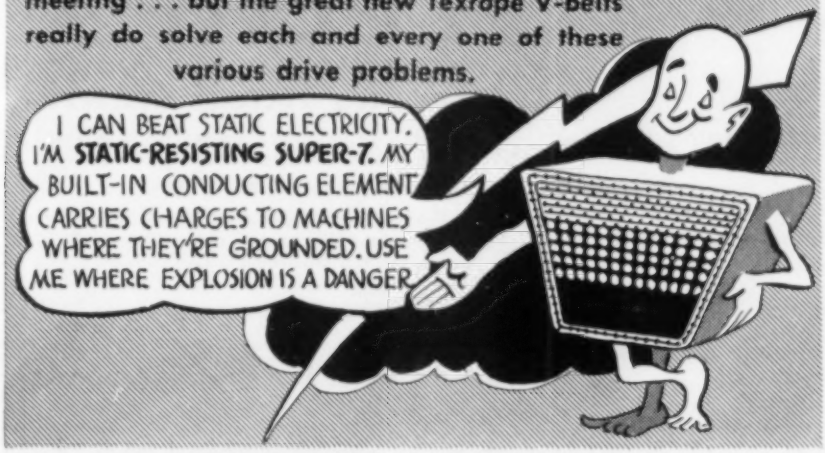
FOR FULL DETAILS ASK FOR BULLETIN S-116.

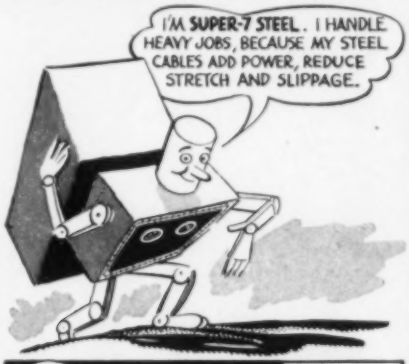
T-1157

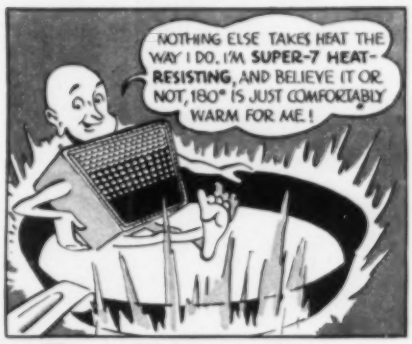
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

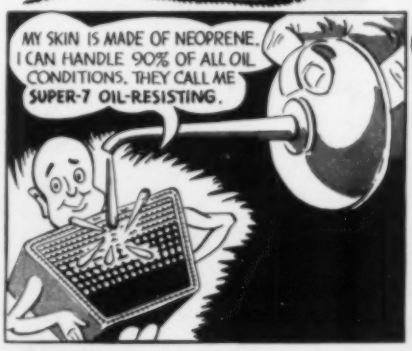
TALL TALES ...but TRUE!

Their exploits may sound like a "Liars Club" meeting . . . but the great new Texrope V-Belts really do solve each and every one of these various drive problems.


I CAN BEAT STATIC ELECTRICITY. I'M STATIC-RESISTING SUPER-7. MY BUILT-IN CONDUCTING ELEMENT CARRIES CHARGES TO MACHINES WHERE THEY'RE GROUNDED. USE ME WHERE EXPLOSION IS A DANGER.







Texrope V-belts are available nation-wide through Allis-Chalmers Dealers and Sales Offices. It pays to make Allis-Chalmers your V-belt drive headquarters.

ALLIS-CHALMERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

A 1960

BULLETIN!

SPEED RECONVERSION WITH HELP OF NEW FREE A-C KIT!

Guide to "How to Take Reconversion Inventory" of Drives, Motors, Pumps

Help in the big job of reconverting for peacetime production is now offered to plants everywhere by Allis-Chalmers Mfg. Co., its district offices and distributors. To all who request it, we're sending the new "Reconversion Inventory Kit", planned to speed the task of determining the condition of your existing equipment — V-belt drives, motors, and centrifugal pumps — which will be used in reconverted production.

SUGGESTS PROCEDURE, STATES STANDARDS

Used by foremen, maintenance men, and engineers, the Kit is a real time-saver . . . leads efficiently to probable trouble spots, helps clear them up. Gives bearing tolerances, resistance formulae, etc., in compact, easily-used form. Check List appraisal charts help determine present and future condition of units inventoried.

HOW TO GET YOUR KIT

For your free Reconversion Inventory Kit, call your nearest Allis-Chalmers distributor or district office, or write Dept. 74, ALLIS-CHALMERS MFG. CO., Milwaukee 1, Wis.

ALLIS-CHALMERS MFG. CO.
Dept. 74, Milwaukee 1, Wis.

Please send Reconversion Inventory Kit free of charge to:

Company.....

Address.....

.....

Attn. of Mr.....

It's got everything

A HIGH-SPEED MOTOR NEEDS-

- Smooth, streamlined appearance—
- Substantial cast iron frames and brackets—quiet, stiff, vibrationless—
- Rotor bearings rigidly braced from base—
- Rotor carefully balanced dynamically and statically—
- Rotor winding designed for the service required. Also patented Elliott diamond cage construction used where needed—
- Substantial, roomy conduit box—
- Construction minimizes windage and magnetic noises—
- Controlled ventilation assures cool operation—

The exceptional features which make this an outstanding motor, are fully covered in the bulletin —on request.

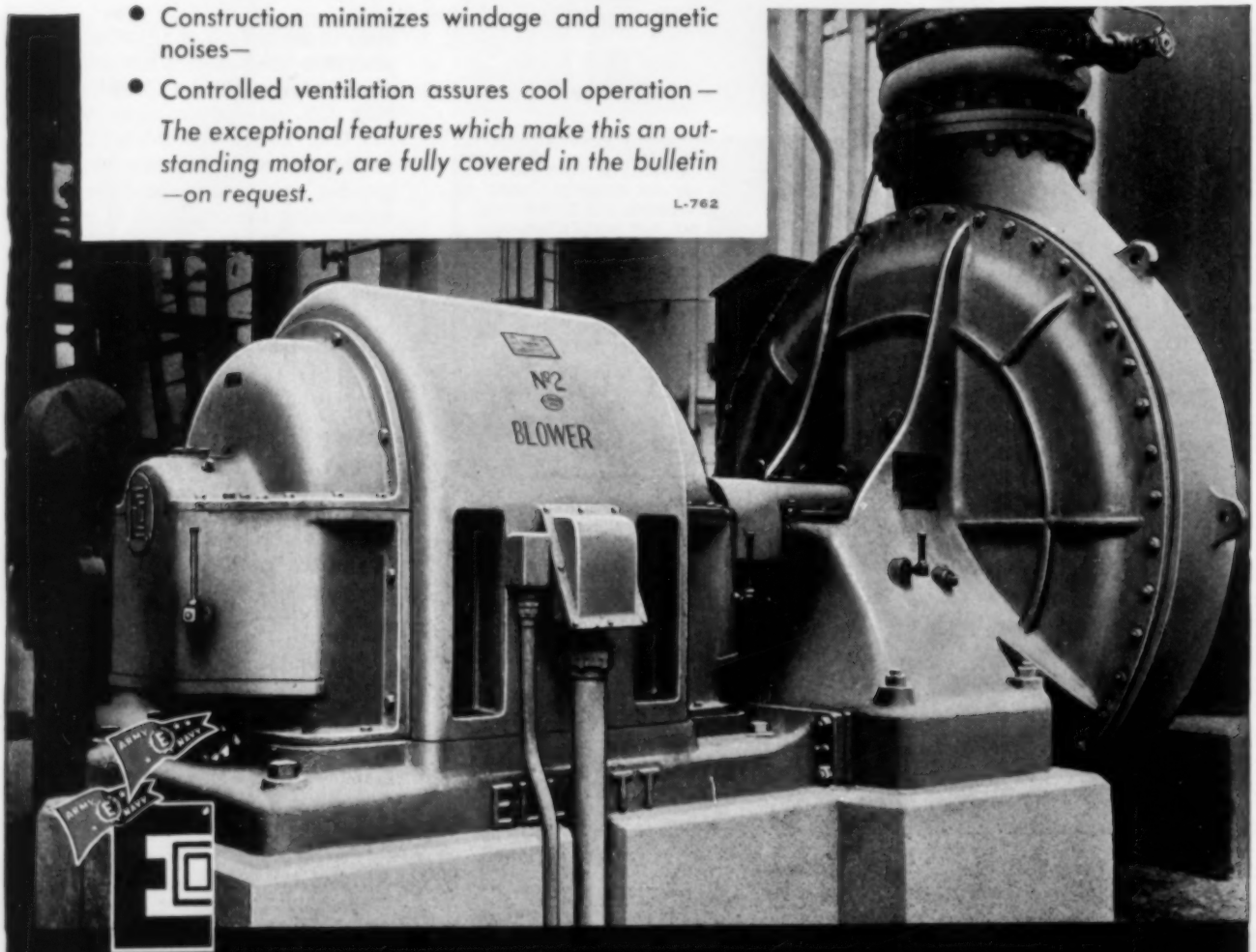
L-762

ELLIOTT

HIGH-SPEED, TWO-POLE MOTOR DRIVING ELLIOTT BLOWER

Supplying air for catalyst regeneration in the Thermofor Catalytic Cracking unit at the 10-7 plant of the Sun Oil Company in Marcus Hook, Pa.

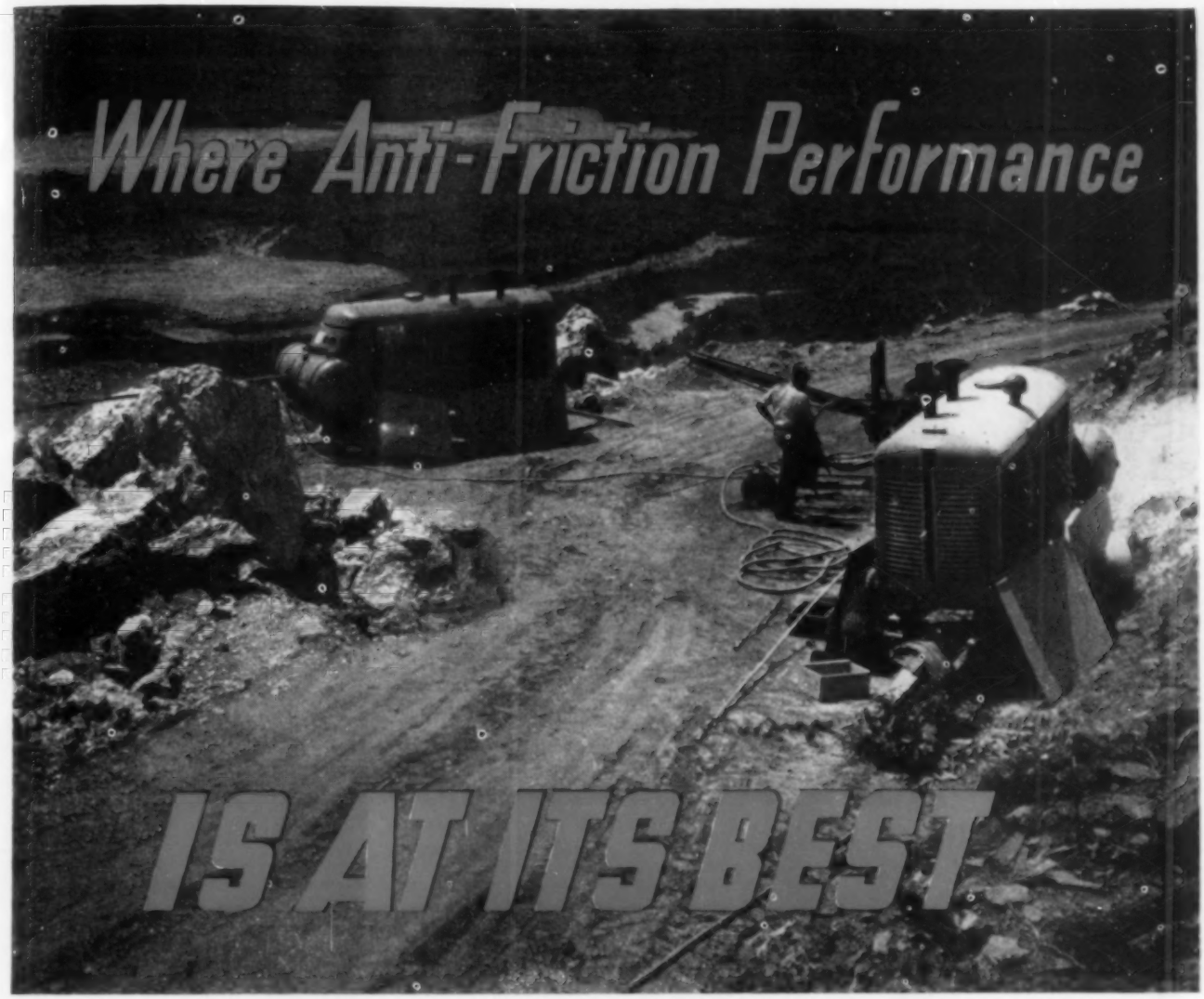
This is a 350-hp splash-proof, squirrel-cage motor operating at 3560 rpm on 3-phase, 60-cycle, 2300-volt power. It is engineered to operate in the open, even to space heaters which prevent condensation on the windings when motor is not in use.



ELLIOTT COMPANY

Electric Power Dept., RIDGWAY, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES



Ingersoll-Rand Mobil-Air Compressors equipped with Timken Bearings working on the construction of a reservoir in New England.

If it's anti-friction bearing performance you want in your new compressor, buy one that is equipped with Timken Tapered Roller Bearings and get all there is in anti-friction efficiency.

With Timken Bearings on the crank shaft, friction is eliminated; shaft wear is prevented; radial, thrust and combined loads are safely carried; the alignment of moving parts preserved; and lubrication simplified.

Timken Bearings make any kind of construction equipment perform better, last longer and cost less for operation and maintenance. That's why more of them are used than any other types of bearings.

Not all tapered roller bearings are Timken Bearings. To be sure, look for the trademark "TIMKEN" stamped on every cup and cone. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

5 BASIC REASONS THAT MAKE COOK'S PISTON RINGS *your best buy!*

COOK'S GRAPHITIC IRON PLAIN RINGS

"COOKTITE" SEALING RINGS

COOK'S OIL CONTROL RINGS

COOK'S GRAPHITIC IRON *Piston Rings*

Designing and operating engineers are primarily concerned with results. That's why so many engineers in both classes consider COOK'S Rings the best buy Here are the 5 basic reasons why:

1—COOK'S GRAPHITIC IRON—This exclusive material has proven time and again it has unequalled wear-resisting and wear-retarding properties. In terms of performance it means "Longer Ring Life—Less Cylinder Wear".

2—TRUE CIRCULARITY—The ability of COOK'S Rings to maintain true circularity on application to the piston is one of their chief advantages. Operation commences with positive contact between cylinder and ring surfaces all the way around.

3—EXACT FLATNESS—COOK'S Rings provide maximum groove seal and hold ring sticking to a minimum because there is a perfect contact between ring and groove land. COOK'S Rings before grinding are a true machined flat annulus as contrasted with a rough individual casting.

4—TINIZED SURFACE TREATMENT—To provide quick seating properties and to promote rapid mating of ring and cylinder surfaces, COOK'S Rings are coated with a non-scuff anti-friction bearing metal. Break-in time and initial cylinder wear as a result are materially reduced.

5—PERMANENT TENSION—First machined to a true circle, COOK'S Rings pass through a mechanical tensioning machine especially developed to impart a force that holds the rings against the cylinder in a manner that provides permanent and equally distributed unit wall pressure.

These reasons add up to More Power—Less Wear. Whether you are designing a new engine or operate an engine that requires ring replacements, call in COOK'S engineer. He will be glad to assist you in obtaining maximum piston ring results.

C. LEE COOK MANUFACTURING CO.

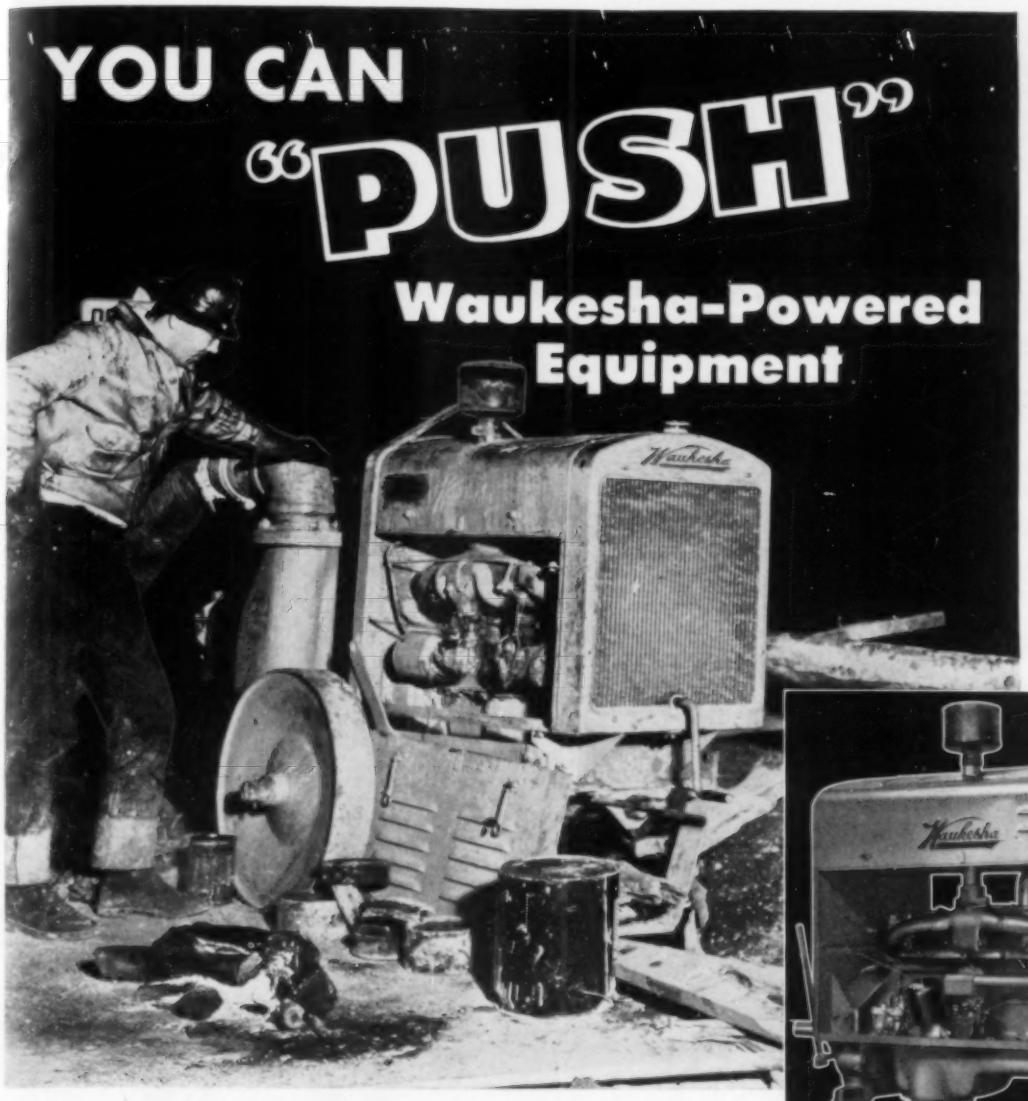
INCORPORATED

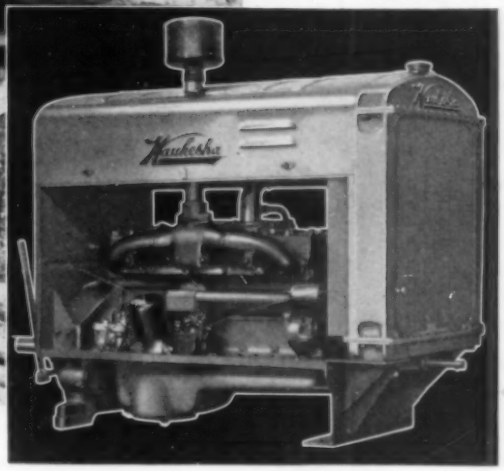
LOUISVILLE, KENTUCKY

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

YOU CAN "PUSH"

Waukesha-Powered Equipment





70 hp. 6-MZRU WAUKESHA Power Unit

• In peacetime . . . just as in wartime . . . time itself is a big factor. Whether it's a pump or a paver . . . truck or tractor . . . crane or compressor . . . if it's Waukesha-powered you can *push* it.

Waukesha Engines *stand up* under round-the-clock, seven-day-week operation. And still they can turn out their full-rated horsepower—with power in reserve, for the pinches. Because forty years of licking the tough jobs is built into every Waukesha Engine!

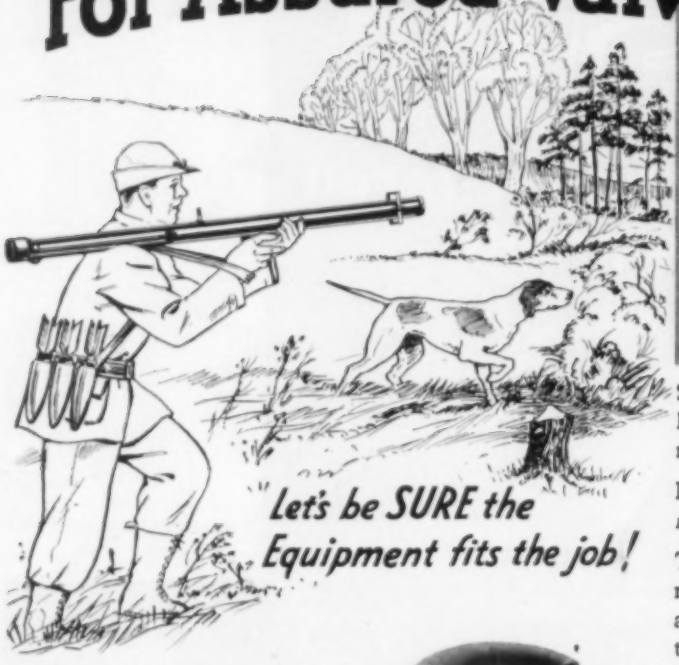
Peacetime Waukesha Engine models . . . modern as tomorrow . . . are on the way. Gas, gasoline, or diesel fuel. With Waukesha wartime-proved ruggedness and dependability *plus*—the result of super power, smoothness, acceleration, and longer life with the greatest overall economy. Consult Waukesha Engineers about your power needs. Get Bulletin 1079.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN • NEW YORK • TULSA • LOS ANGELES

WAUKESHA ENGINES

For Assured Valve Performance

Consult POWELL ENGINEERING *First*



Shooting quail with a bazooka would be nonsensical. But trying to make a valve do a job for which it is not suited doesn't make much sense, either.

For assured performance in flow control the valve *must fit the job.*

That's why Powell maintains a staff of valve engineers who are always at your service for consultation and advice. And if you have any individual flow control problems, Powell Engineering is ready to design the correct valves to meet them.

Fig. 95—Bronze Dash Pot Check Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed cap, and regrindable, renewable wear-resisting bronze disc. Because of the cushioning effect of the plunger in the dash pot, the seating of the disc is practically noiseless.

Fig. 150—Bronze Globe Valve for 150 pounds W.S.P. Screwed ends, union bonnet and renewable vulcanized composition disc.

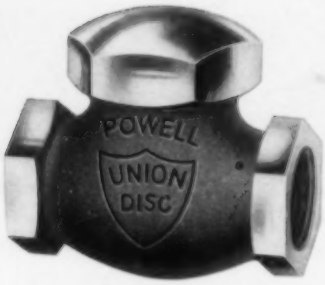


Fig. 158—Bronze Horizontal Lift Check Valve for 150 pounds W.S.P. Screwed ends, screwed cap and renewable vulcanized composition disc.

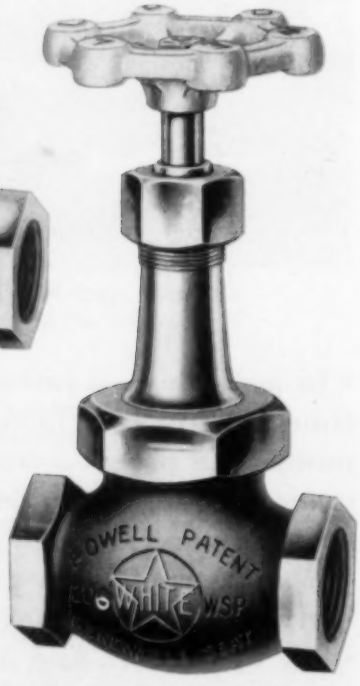


Fig. 1708—Bronze Globe Valve for 200 pounds W.S.P. Screwed ends, union bonnet, renewable seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze semi-cone, plug type disc.

The Wm. Powell Co.

Dependable Valves Since 1846

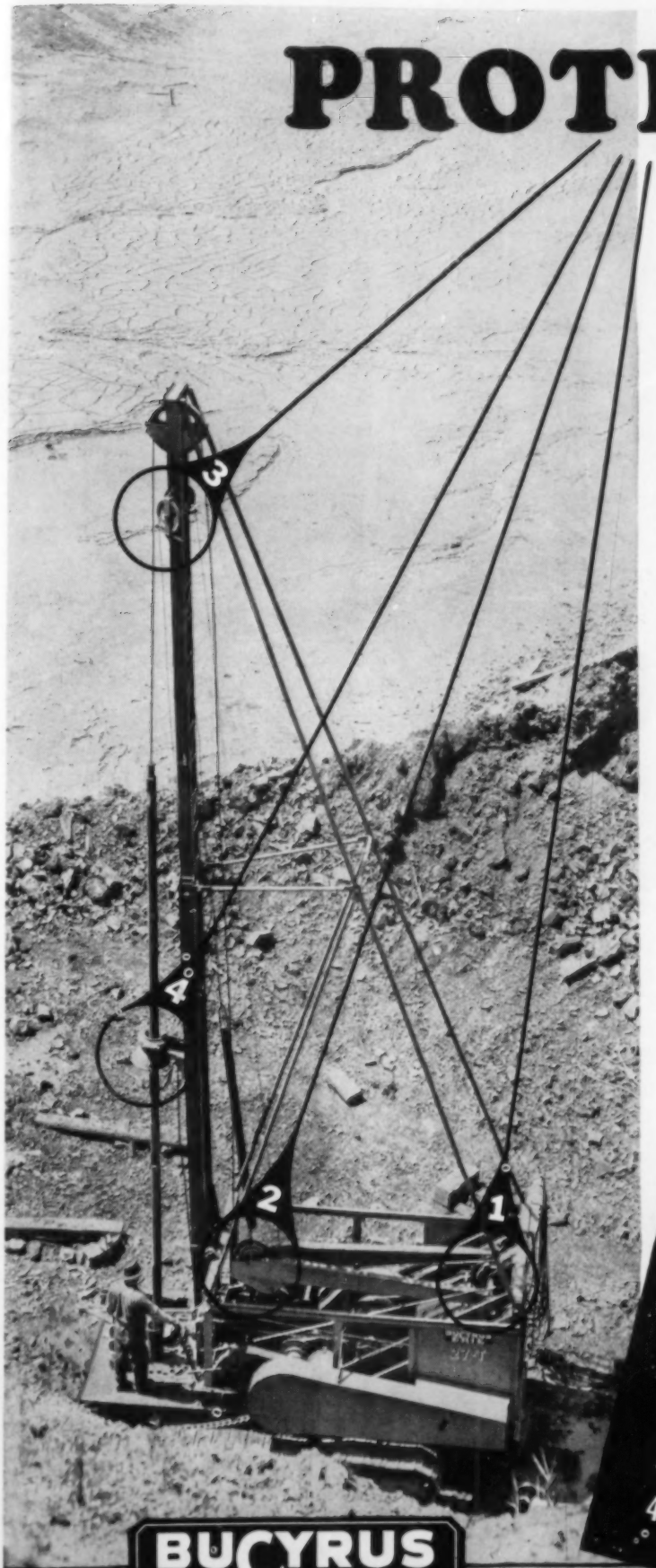
Cincinnati 22, Ohio

DISTRIBUTORS IN PRINCIPAL CITIES

POWELL VALVES

PROTECTION

that cuts maintenance and line costs



It's effective application of power that gives Bucyrus-Erie blast hole drills outstanding footage-efficiency, but it's defense against shock that does so much to keep maintenance and line costs low. The critical points — where the drill line comes in contact with the machine after impact of tools — are rubber insulated to absorb the shocks of drilling: (1) at the heel sheave, (2) at the spudding beam sheave, (3) at the crown sheave. At points (1) and (2), insulation consists of live rubber rings mounted on the hubs of the sheaves. Protection at the crown sheave (point 3) is obtained with a rubber shock absorber—a series of rubber rings separated by steel plates and mounted between the sheave guide and a cross member on the derrick. In addition (point 4), all tool guides (except on Model 22-T) are equipped with live rubber rings to absorb shocks involved in guiding tools. With these critical points protected, the shocks and vibrations that ordinarily cause high maintenance and line deterioration are reduced to harmlessness. The result to you is a big saving in drilling: steady high footage at low per-foot cost.

It will pay you to investigate these models

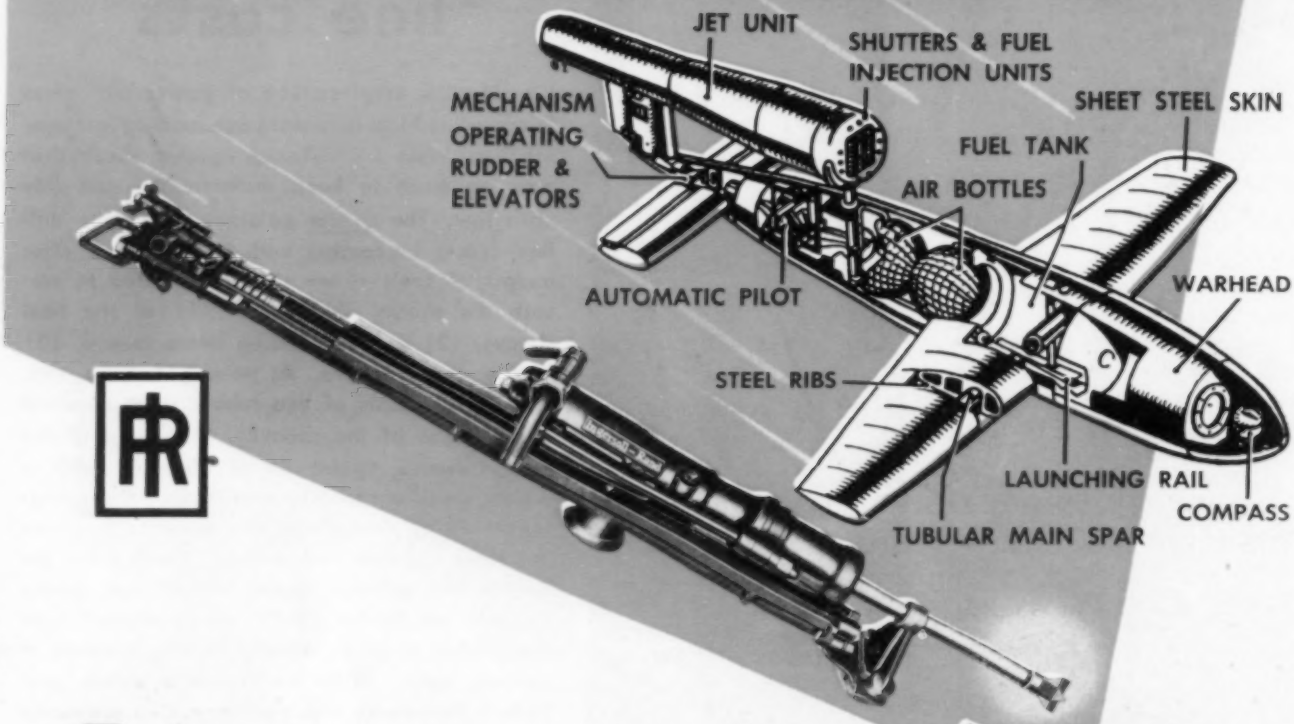
22-T for 5-5/8" to 6-5/8" holes
27-T for 6" to 6-5/8" holes
29-T for 9" holes
42-T for 9" to 12" holes

5845

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

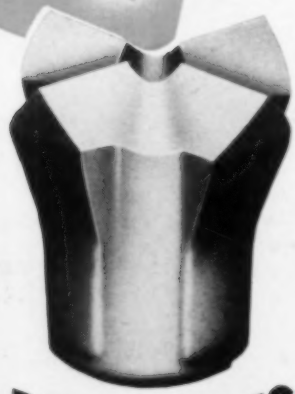
...Both need WAR HEADS



The effectiveness of the flying bomb depends upon the warhead in its nose — a 2000 lb. charge of explosive. All of the intricate mechanism in this weapon — the gyroscope compass, jet propulsion, and automatic pilot — merely serves to deliver the explosive to its destination.

In a similar way, the precision manufacture and the unique valve design of the DA-35 Drifter serve only to develop the power necessary to drive a bit into the rock. Despite the fact that the high drilling speed of this machine has enabled it to establish new tunnel-driving records, the use of a proper warhead — a Jackbit — is essential to peak efficiency.

For example, on one job the drilling rate of DA-35 Drifters was increased from 16 to 22 inches a minute when Jackbits were put to work. On another job Jackbits reduced the time per round drilled by 26%.



JACKBITS

YOUR ROCK DRILLING WARHEAD

There's a size and style for every rock condition. They're backed by men who are rock drilling experts.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 15-734

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

and the Victory won –

"This is a victory of more than arms alone. This is a victory of liberty over tyranny . . . . . .

"Back of it all was the will and spirit and determination of a free people——who know what freedom is, and who know that it is worth whatever price they had to pay to preserve it.

"It was the spirit of liberty which gave us our armed strength and which made our men invincible in battle. We now know that that spirit of liberty, the freedom of the individual, and the personal dignity of man, are the strongest and toughest and most enduring forces in all the world . . . . . .

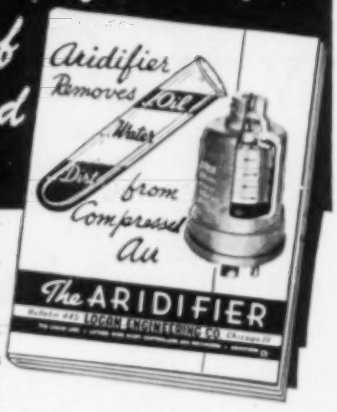
"And so on V-J day, we take renewed faith and pride in our own way of life . . . . . renewed consecration to the principles which have made us the strongest nation on earth and which, in this war, we have striven so mightily to preserve.

"Those principles provide the faith, the hope and the opportunity which helped men to improve themselves and their lot. Liberty does not make all men perfect nor all society secure, but it has provided more solid progress and happiness and decency for more people than any other philosophy of government in history. And this day has shown again that it provides the greatest strength and the greatest power which man has ever reached . . . . . "

President Harry S. Truman
V-J Day radio address

C. M. EASON, INDUSTRIAL CLUTCH CO.
Waukesha Wisconsin

12 pages of data for users of Compressed Air!



Contamination in compressed air—its damaging effects on tools, valves and air motors—and an effective, final remedy—are comprehensively presented in this new bulletin. Shows how the Aridifier effectively removes moisture, dirt and oil from compressed air—and why it is replacing methods that provide only partial removal. Write today for Bulletin 445.

LOGAN ENGINEERING CO.
4911 Lawrence Ave., Chicago 30, Ill.

Logan ARIDIFIER
Dries and Cleans Compressed Air

Two Names That Mean Longer Safer AIR HOSE Service!

"SUBWAY", Style D-142

All-Synplastic construction, with tube, carcass and cover especially made for heaviest duty. One of Goodall's oldest and best-known brands. Sizes ½" to 1¼".

"MINE KING", Style L-56.

All-Synthetic, moulded-and-braided construction. A thick, tough cover withstands the severest abrasive wear. Available in continuous lengths up to 500 feet. Sizes ½" to 1".

Contact our nearest branch or main office for details and prices.

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The Goodall-Whitehead Companies
Philadelphia - Trenton - New York - Chicago
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Factory - Trenton, N. J. Established 1870

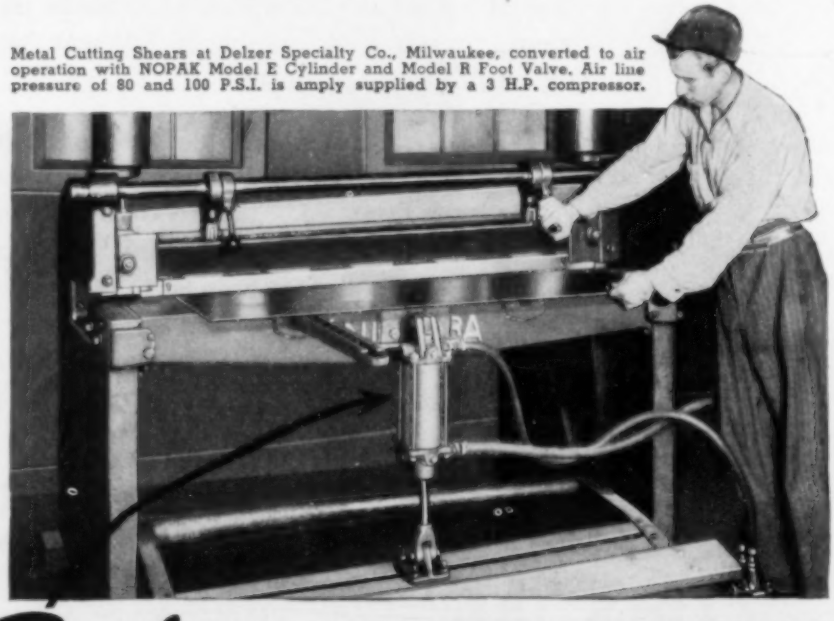
● A standard NOPAK Model E Air Cylinder applied to a treadle operated, sheet-metal shears has increased its cutting capacity at least 500% . . . and enables it to cut heavier gauged metal. The strain and fatigue of strenuous manual effort has been eliminated, an important factor in this instance because the operator has other duties to perform.

The cylinder is controlled by a NOPAK Model R Foot Valve, leaving operator's hands free to feed and remove the metal sheets and manipulate locking levers . . . while speeding up the cutting cycle.

This simple installation of a NOPAK Valve and Cylinder suggests how manually operated machines in your plant may be converted to Air or Hydraulic Operation.

Write for NOPAK Bulletin 87.

Metal Cutting Shears at Delzer Specialty Co., Milwaukee, converted to air operation with NOPAK Model E Cylinder and Model R Foot Valve. Air line pressure of 80 and 100 P.S.I. is amply supplied by a 3 H.P. compressor.



AIR POWER Replaces FOOT POWER!

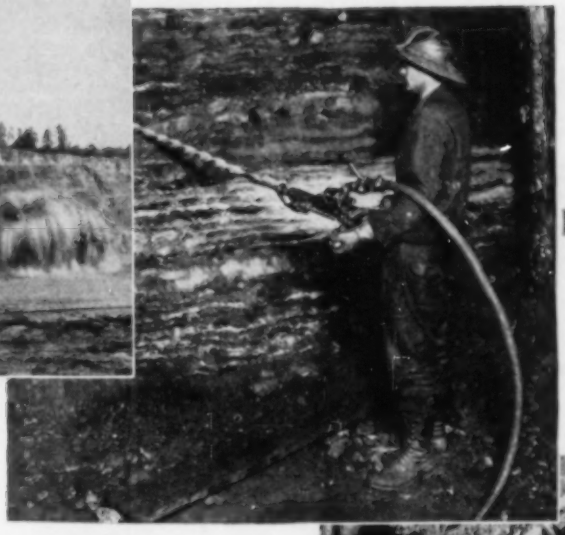
NOPAK Model E Cylinder Pendulum Mounting.

GALLAND-HENNING MFG. CO., 2759 S. 31st St., Milwaukee 7, Wis.

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

A 4757-½HA



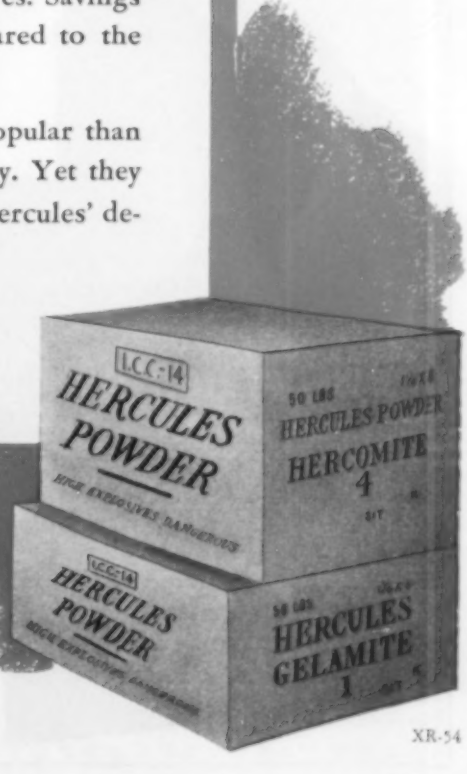
FOR MAXIMUM ECONOMY

in Quarrying, Metal Mining, Construction

Users of Hercomite* and Gelamite* report maximum breakage for every dollar's worth of explosives. Savings of 10% to 15% have been common, compared to the older types of explosives.

Hercomite and Gelamite are now more popular than ever before—the best proof of their efficiency. Yet they are but one example of many outstanding Hercules' developments in the field of explosives.

HERCULES



EXPLOSIVES DEPARTMENT
HERCULES POWDER COMPANY
INCORPORATED
932 KING STREET, WILMINGTON 99, DELAWARE

*Reg. U. S. Pat. Off. by Hercules Powder Company

XR-54

Here's Money-Saving Protection For Your Compressed Air Operated Machinery and Instruments

Now, regardless of volumes required or fluctuating pressures, the new Bird-White Pur-O-fiers completely and effectively remove all moisture, oil, dirt and other foreign matter from compressed air or gas lines—preventing costly corrosion and gumming in compressed air-operated machinery and instruments.

Operating on the principle of centrifugal action, a high speed Turbo-rotor forces the tiny particles of foreign matter outward where they are trapped and drained off.

Single units can accommodate up to 100 cubic feet. Above this range multiple units are recommended.

New applications for Bird-White Pur-O-fiers are being developed every day. Write for Bulletin No. 10 giving complete information.

BIRD-WHITE COMPANY
Dept. CA
3120 West Lake Street
Chicago 12, Illinois

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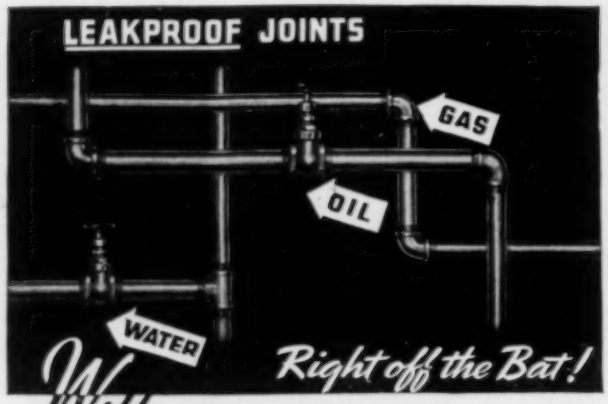

With JOHN CRANE

Insoluble PLASTIC LEAD SEAL

- *Insoluble* in water, gasoline, propane, CO^2, etc. Won't wash out.
- *Seals quickly;* fills clearances and imperfections.
- *Stops galling, rust.* Never hardens; joints easily taken apart later.
- *Ready for use,* in 1, 5, 7-lb. cans.

Order a trial can of Plastic Lead Seal—watch it reduce maintenance in your plant or product.

CRANE PACKING COMPANY 1808 CUYLER AVE. • CHICAGO 13, ILL.

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CRANE PACKING CO., LTD., Hamilton, Ontario, Canada
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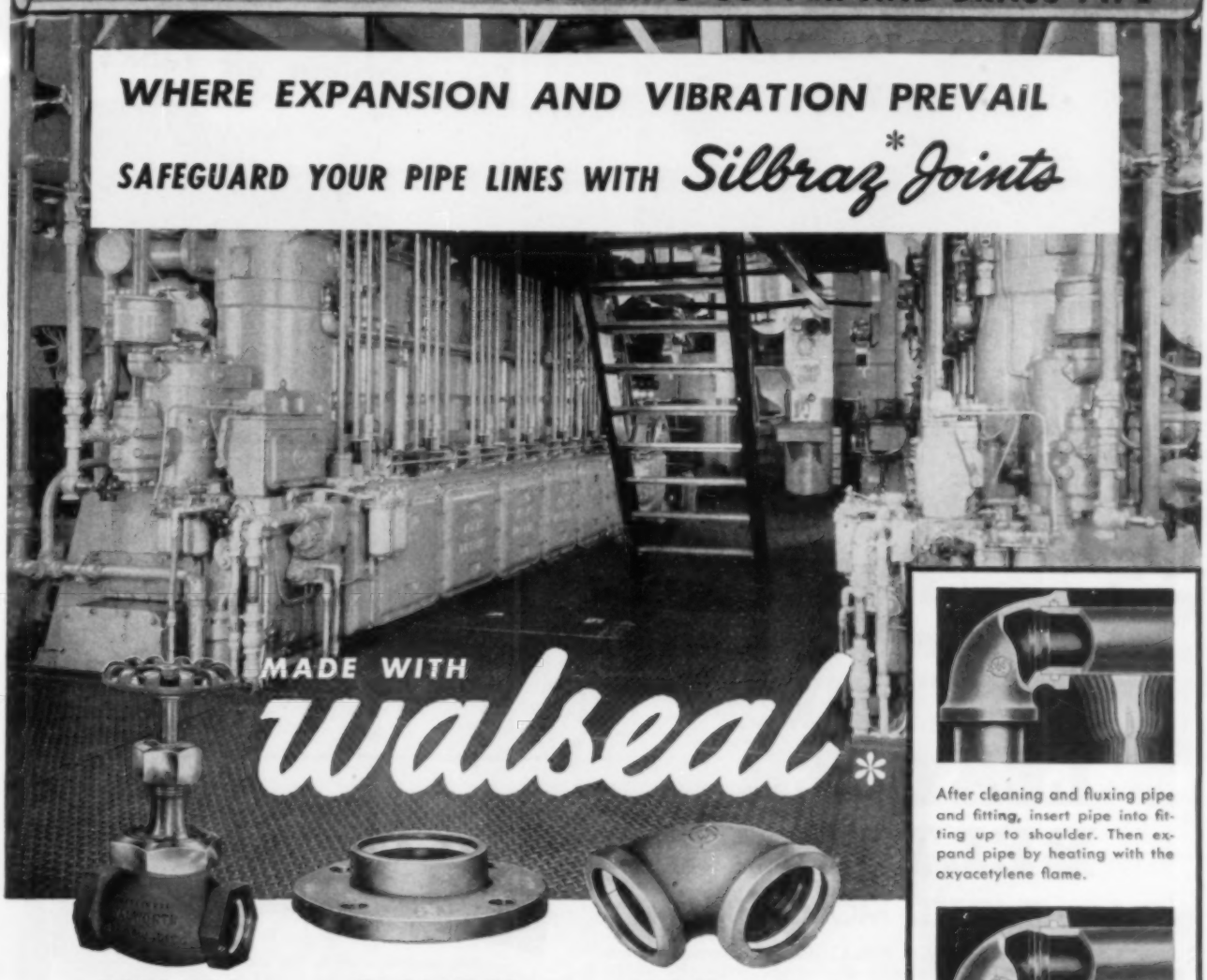

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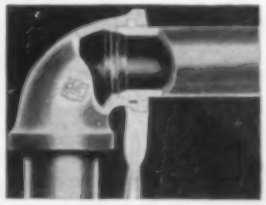

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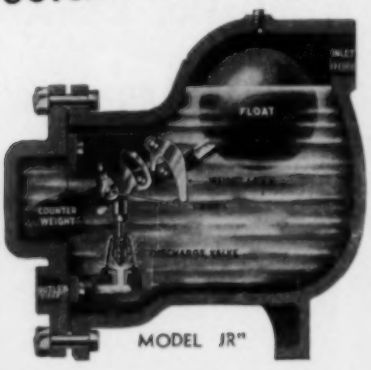

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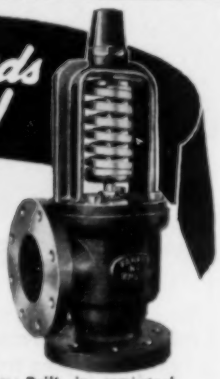

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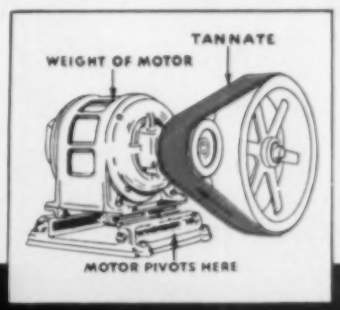

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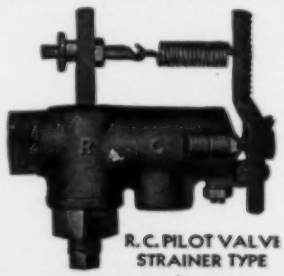

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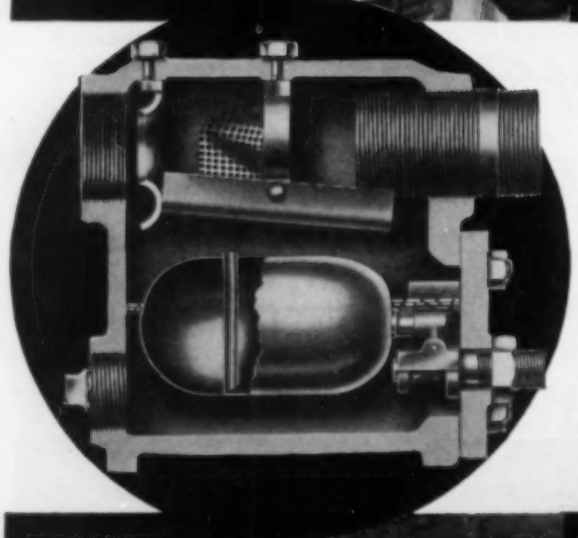

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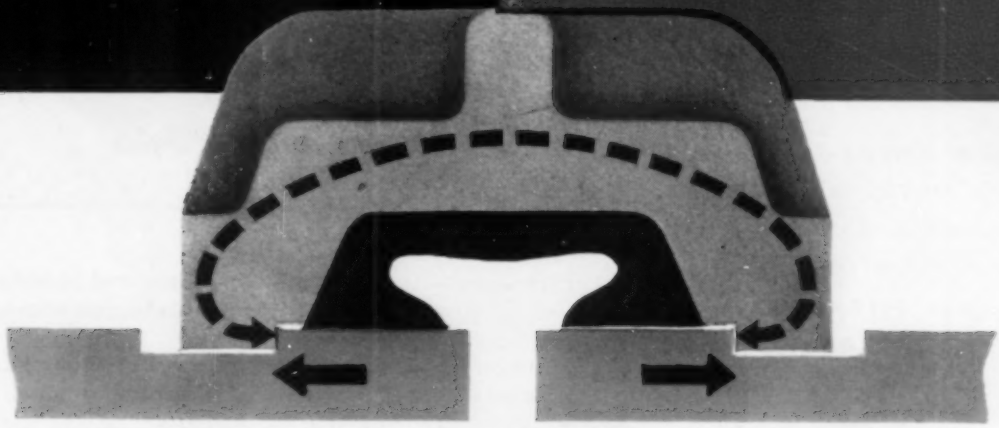

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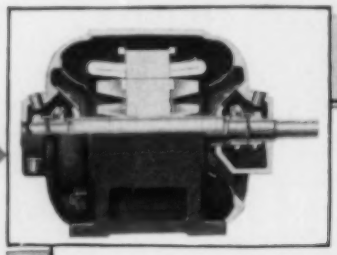
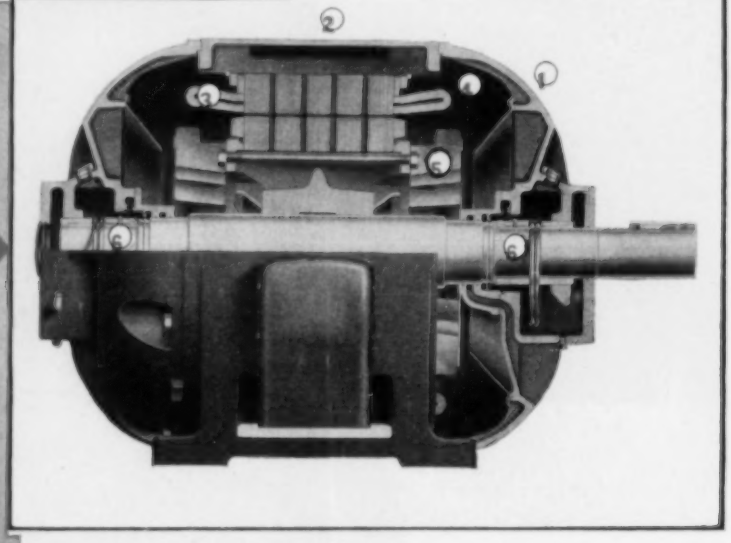
to 2000 hp





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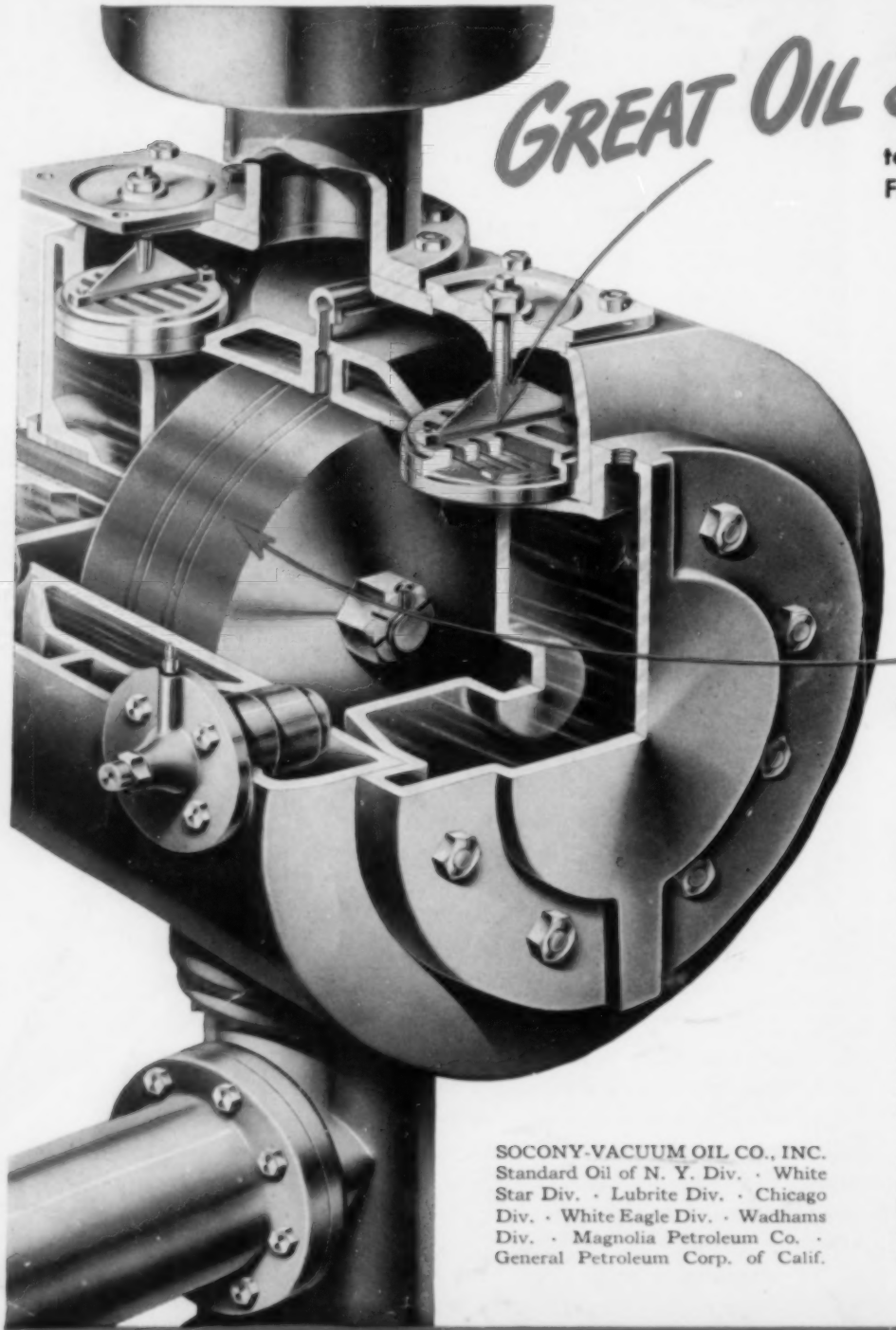

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